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The Geographical Journal

Vol. LXIX No. 2 February 1927

SOUTH-WEST TANGANYIKA TERRITORY

C. Gillman

Read at the Meeting of the Society, 22 November 1926.

MODERN geography demands Regional Surveys conducted by experts working in cooperation. But the same surveys are required if we wish to administer and develop our territories beyond the seas along the only sound lines—those dictated by geography. Such surveys ought, therefore, to be established and furthered at a rate which will guarantee full knowledge within a reasonably short time. That they will cost a good deal there can be no doubt, but that this money will be well invested, apart from the infinitely more important credit-balance of increased human well-being, there can also be no doubt.

In the meantime this regional work, at least in East Africa, is going on in a haphazard fashion. Administrators, agricultural officers, doctors, and engineers have many opportunities, during their official wanderings, for contributing to an ever-wider acquaintance with the countries concerned; but however thoroughly we have grasped the necessity for geographical studies, however ardently we endeavour to add to our knowledge, our often narrowly defined official duties do not leave us sufficient time for thorough investigations in the field, for the essential preparatory work prior to an expedition, and least of all for anything like a sufficiently complete elaboration of the results after our return. Besides, we are, most of us, amateurs; and even those who may possess sound knowledge in one restricted field are bound to be amateurs in most others.

You will not expect me to allow the truth of Dr. Dixey's recent statement that the engineer, when he *does* grasp the geography of the country, does so probably unconsciously (*Geogr. Journ.*, **68**, p. 137). The engineer must fully understand that penalties are attached to any disregard of geography, and it was as an engineer in search of railway lines that I have recently spent seven months zig-zagging through the south-western districts of Tanganyika Territory, of which I wish to give you a geographical description to-night. It is an area which has been much to the front of late, ever since the labours of the East Africa

Commission have drawn attention to its dormant possibilities, and the difficulties of which, physical as well as economic, must be understood if the right thing is to be done about its development.

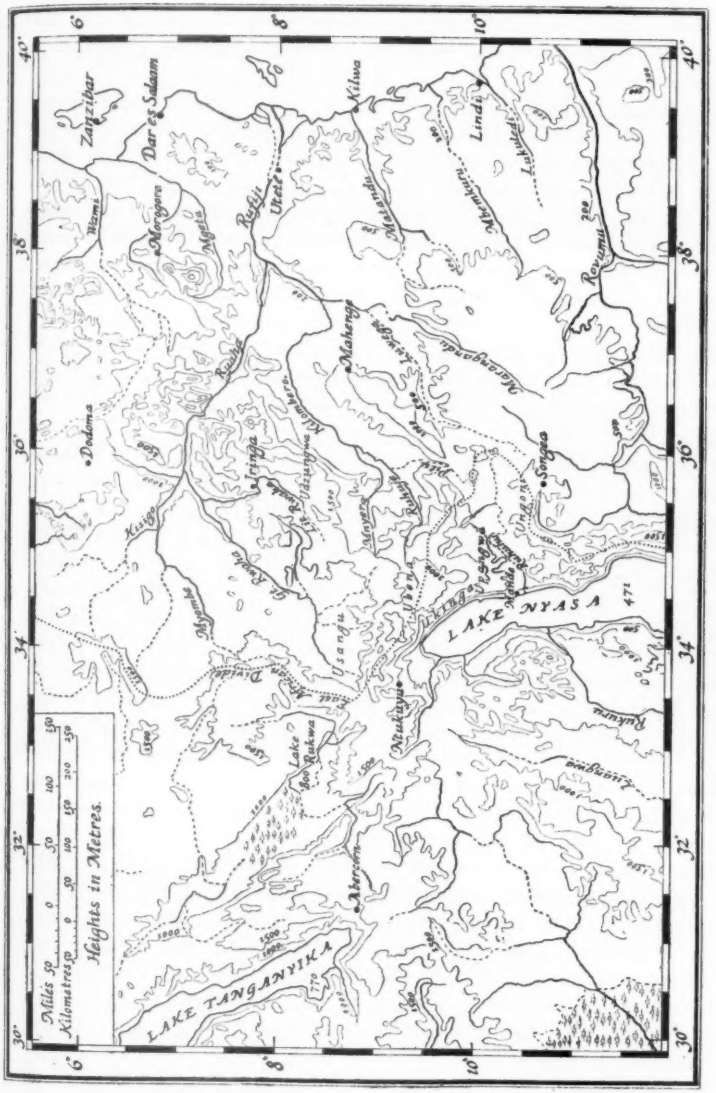
The region which, for lack of a more suitable term, I call South-West Tanganyika Territory, may be defined as follows: Geographically it comprises the drainage areas of the Kilombero and upper Rovuma, the mountainous east coast of Lake Nyasa, the volcanic region to the north of that lake, and the westwards adjoining highlands of the Nyasa–Tanganyika divide, that is the country between roughly S. lat. 8° and 11° and E. long. 33° and 37°. It is bounded in the west by the lake and the western scarp of the Nyasa trough, and is separated from the coast of the Indian Ocean by the wide strip of practically uninhabited, badly watered and bush-covered ground which forms the hinterland of Kilwa and Lindi. Politically the region is taken up by the administrative districts of Mahenge, Songea, Rungwe, and the southern part of Iringa (Ubena and Udzungwa). Iringa proper, *i.e.* Uhehe, is thus not covered by this definition; for geographically it belongs to the basin of the upper Ruaha and economically to the central belt of Tanganyika Territory, to whose main artery of trade, the Central Railway, it has access over comparatively easy ground.

Of the early explorers who have given us first impressions of parts of this area are Livingstone, Elton, Cotterill, Giraud, and, above all, Joseph Thomson, whose keen geological eye made him recognize very early the Rift character of the Nyasa trough. Kerr-Crosse's wanderings of 1890 through Kondeland and the western plateau contain much of interest.

The first detailed descriptions, approaching in many instances to regional studies, are contained in the two great and well-known works by Bornhardt, a geologist, and Fuelleborn, a medical man with zoological and ethnographical training. The former's careful surveys in the southern and western part of our area, his well-grasped geological outlines, and above all his vivid and lucid pictures of the country which I reckon among the best I have read in scientific geographical literature, still form a most accurate foundation to our knowledge. Fuelleborn, on the other hand, contributes much useful matter about the peoples which is of particular importance, as his observations were made at a time when contact with European civilization had only just been established.

A good and concise summing up, a desk-study based on everything that was known of the western part of our area in 1913, is Miss Frey's monograph on what was then German Nyasa Land.

On the eastern portion geographical literature is very scant. We have Dr. Scholz' useful east-west geological traverse between Mahenge and Ntukuyu; and long before him Dantz had supplemented Bornhardt's observations in some parts, without, however, reaching his predecessor's



Sketch-map of South-West Tanganyika Territory

high standard. The report and sketch-map by a German railway reconnaissance party who, in 1912, were the first to penetrate into the wilds of the Pitu valley, are most disappointing documents from the technical point of view, and contribute next to nothing to our geographical knowledge.

Of maps, the 1 in 1 Million and 1 in 300,000 sheets, compiled almost exclusively from route surveys, have all the disadvantages of such maps: mainly this, that the amount of detail and the accuracy of representation varies very considerably and often within a few miles. But of two restricted areas we possess better material: Kohlschuetter's 1 in 100,000 map of the central Livingstone Mountains, and a very beautiful and, as regards topographical detail, very accurate map to the same scale, of the Nyasa trough between the north end of the lake and Rungwe volcano. But the latter, unfortunately, does not contain a single altitude! For the purposes of this paper I have therefore fallen back on the R.G.S. 1 in 5 Million map prepared in 1918 for General Smuts' lecture, on which I have endeavoured to correct certain portions in accordance with my own recent surveys.

Orographical Features.—That our area, belonging to the major geographical unit of High Africa, has participated to a great extent in the process of fracturing which has made East Africa the classical ground for the study of Rift valleys, there can be no doubt. That the Nyasa trough is a Rift, that the great and sudden drop east and south-eastwards of the high plateau into the coastal foreland is intimately connected with great fault-lines, who can deny? But in the absence of strictly geological proofs, it is by no means easy, it is even in many instances distinctly premature, to base one's conceptions of the country's tectonics on purely morphological features of the present day. Is a high mountain wall rising in clear-cut lines from a vast expanse of lowland a fault-scarp, or is it an erosive escarpment? How often is the African geographer faced with this dilemma and how often does he succumb to the temptations of a pre-conceived theory! How rarely, too, when listening to opposing statements about one and the same feature, does one meet with an instance of an explorer having realized the fact that fault-scarps of such tremendous height must of necessity have taken a very long time to develop, and that throughout all that time, and from the very beginning, erosion has played on the gradually appearing front of the up-standing crust-block! Only patient and painstaking detailed mapping will provide the clue for deciphering the historical evolution of the forms which we see to-day; and in the meantime we should take the terms "scarp" and "escarpment" *cum grano salis.*

The northern part of South-West Tanganyika Territory is taken up by the high-plateau block of Uhehe, Ubena, and Ukinga. Northwestwards this block drops either in steep scarps or by more gentle surface forms to the high-lying upper basin of the Great Ruaha, whilst east

Phot. R. W. Norton

South Uluguru Mountains

Phot. C. Gillman

Mt. Yunge, East African scarp

Phot. R. W. Norton

Hot springs near Mgeta

Phot. R. W. Norton

Embouchure of Ruaha gorge

Phot. R. W. Norton

Lowest part of Ruaha gorge

Phot. C. Gillman

Udzungwa highlands

and south-eastwards the great East African Scarp towers beautiful and high above the southwards ever-widening strip of the coastal hinterland. This latter, in itself a region of very varied relief, still includes in places residual plateau masses which, like the Uluguru and Mahenge mountains, rise as outliers of the central crystalline plateau from a rough but on the whole much lower surface of old and new sedimentary formations.

Crowned, especially in its southern parts, by magnificent rain-forest which is nourished by the moisture precipitated from the air of the prevailing south-east trade winds when it strikes the cool upper edge of the plateau, breaking down in steep slopes or rocky bluffs, this great scarp forms for hundreds of miles a formidable barrier to east-west communications. Indeed, the linking up of the coast with the vast plateau-lands between S. lat. 5° and 9°, and thereby the tapping of lake Tanganyika, has only been made possible by the existence of the one narrow gap in this otherwise uninterrupted mountain wall, found in the mature valley of the Mukondokwa. Obviously a relic of pre-scarp morphology, it has, with its easy grade and well-advanced stage of erosion, not only pointed the way westward to the old slave traders, but has also determined the alignment of the Central Railway trunk line. The only other gap, the geologically very young, narrow, and steep-sided transverse gorge of the Ruaha, 100 kilometres farther south, is not only quite impracticable for modern means of communications, but does not even afford room, between its cliffs of sheer rock and the tossing waves of East Africa's longest river, for a primitive native path.

Conditions, however, change markedly and quite suddenly where, at about 9° S. lat., this great scarp takes a decided turn to the west and gives way to surface forms which, whatever their morphological history may have been, are now undoubtedly those of a typical erosive escarpment. Five great streams—Kihanzi, Mpanga, Mnyera, Ruhuje, and Pitu—a veritable East African "Punjab," combining to form the Kilombero, and gnawing with their countless tributaries deep into the southern tableland, have succeeded in turning the former high and almost level ground for 100 kilometres west and south into an amazing mass of ridges and valleys. But although the result is a general slope of the country from the foot plain to the rolling uplands far more gentle than that of the scarp further north, the work of erosion has nowhere advanced sufficiently far to carve out a second Mukondokwa highway, all the valleys being still in an unripe state, with gorges and frequent rapids in their middle courses.

Seen from above, from the eastern edge of the Ubena peneplain, what a tremendously vigorous dissection! Geographically, erosion approaching maturity, the ridges on the whole still flattish, but valley-density almost at its maximum, and slope-erosion eating rapidly into the divides. Emotionally, an awe-inspiring multitude of valleys, large,

medium, small, with the intermediate backs at a practically uniform level, hardly a bush, four or five trees in 100 square kilometres, grass and bracken covering. as far as the eye can gaze an endless vista of valley upon valley!

The peneplain itself, or what not long ago must have been a peneplain, extends westward for about 30 kilometres, rising only 130 metres, until it abuts on more hilly ground, the last gentle eastern waves of the Livingstone ranges melting imperceptibly into the plateau step.

Farther north, beyond the headwaters of the Ruhuje and Mnyera, the flat softly undulating country merges, slightly rising, into the similar ground of southern Uhehe, and towards the north-west it is drained by the valley of the Mbarali into the great plain of the upper Ruaha, the so-called Usangu Plain. Here, though, the topography at the foot of what looks like a gigantic scarp by which the northernmost and highest portion of the Livingstone Mountains breaks off in the east, becomes once more markedly accentuated. But it would seem as if the maximum of valley density had already been surpassed, that erosion is in a far more advanced stage than farther east in the drainage area of the upper Ruhuje. This is not surprising, as the basis of erosion is the Usangu Plain, which lies only 1000 m. below the central Ubena plain—the Kilombero–Ruaha Divide lying here at approximately 2050 m.—whilst the drop to the Kilombero attains nearly 1700 m. But quite apart from general considerations of drainage, the morphological detail of the slopes also points towards a more mature stage of erosion. While the lower and middle slopes are as a rule gentle, the higher slopes of the generally well-curved, often narrow ridges, show everywhere much outcropping rock, a peculiarity which can best be explained by increased removal of the deep residual soil, a removal which, *e.g.* in the Ruhuje drainage, has only just commenced. But this more mature stage notwithstanding, the valleys are still decidedly deep and often form falls.

If we now turn westward we find the remains of a former mountain system superimposed on the plateau. Gentle, much-denuded ridges first, and then chain upon chain of hills, each succeeding one a little higher, and all with the tendency to increase in height towards the north, where altitudes of over 2900 m. are attained. These are the famous Livingstone Mountains, which, contrary to Thomson's conception, are an individual unit, orographically as well as geologically, and not merely the higher parts of the old plateau. For while the latter in this region consists of a great granitic laccolith which probably has something to do genetically with the forming of the Livingstone Mountains, these are composed largely of ancient highly metamorphosed schists, capped in places by little disturbed and likewise very old though not metamorphosed shales and sandstones.

In their central portion they still show senile forms; but as we proceed west each day's march leads through ever more accentuated, ever

more picturesque scenery, until one day we step on to their western edge, and thence obtain views which are not only most instructive from the geographer's and the engineer's point of view, but must be counted among the finest the world can offer. From one's feet the terrifically steep slopes drop away, forming a foreground of the wildest mountain scenery; in the south this foreground of rocky cliffs dips into the great lake; whilst in the north, separated from the sand-dunes of the northern shore by the flat stretch of delta country far down in the wide trough, rises a volcanic landscape of cones and ridges which culminate in the noble lines of Mount Rungwe; and beyond in the far west rises a similar, though somewhat lower scarp from a sea of mist and cloud.

Geographically, this combination of typical scarp and typical volcanic topography, side by side, with the great lake and its shore-lines thrown in as a feature of additional interest, forms an object lesson of so wide a scope that it seems impossible to find its equal anywhere else on this Earth. And to the engineer anxious to link up Nyasa with the outer world, the tremendous natural difficulties awaiting such a scheme are once more, and more plainly than ever, brought to notice. From Manda Bay, just discernible on the far southern horizon, up north along the long unbroken line of the Livingstone scarp, then sweeping west and formed by the volcanic masses of Rungwe and the Mporoto chain, and finally completing the circle by the long southward trending scarp of Bundali, an uninterrupted, tremendously steep and horribly cut-up slope of an average height of 1500 m.!

To this difference of height one must add the climatic factor of the large lake which, under the heat of a tropical sun, forms a great natural reservoir for a constantly circulating stream of water, rising to-day in the form of vapour to be re-condensed on the cool upper slopes and to re-descend to-morrow with tremendous force, facetting on its way the slopes of the vast amphitheatre into knife-edge ridges and deep ravines.

It is no exaggeration to say that by the sharpness of its features, the steepness of individual slopes, this scarp scenery surpasses Alpine morphology, although once more one cannot help being surprised at the comparative rarity of naked rock. I have actually measured slopes of 75° which still retained their residual covering of clayey red or brown earth. On the other hand, it is well worth noting that the average slope of the scarp as a whole is by no means as steep as one might think when either facing or climbing it, or looking down it from the top. Several clinometer measurements taken along a distant cross-section on the steepest part between the north end of the lake and the Ruhuhu delta, have revealed the astonishing fact that the fairly even slope from the top edge to the bottom seldom, if anywhere, exceeds 30°.

As already stated, great volcanic masses form a very serious obstacle against access to the lake from the north. They have risen over the shattered crust at the point where the Nyasa Rift branches into its two

daughter rifts, that of lake Rukwa trending north-west and that of Usangu running north-east and joining up, very probably, with the Great East African Rift Valley. This volcanic blocking of the road has, to judge from quite recent statements, not always been realized, although it is a feature of the greatest importance. For the Mporoto chain, a more or less level volcanic ridge stretching east-west from scarp-edge to scarp-edge, and breaking down in a great curved and much-dissected slope towards the south where Ntukuyu and Konde Land lie, would force any road or railway attempting to reach the lake from the upper Ruaha, to climb to at least 1900 m. (the lowest point on the ridge which here forms the Rufiji–Zambezi Divide), and would thus handicap such a line with a loss of level against export of more than 1400 m.

Thus the great Nyasa trough, sunk deep into the old Central African Plateau as a consequence of comparatively recent and large-scale tectonic happenings, lies carefully guarded against the inroads of civilization. Only at one point the guarding bulwarks of the north and east appear vulnerable. This is the Ruhuhu depression of which more will be said presently. Here a word must be added with regard to the geographical peculiarities of the lake itself as a line of communications.

When looking at a small-scale map one is easily lured into a comparison of the great Central African lakes with other large sheets of water which, like the North American lakes, have played so important a part in the commercial and industrial development of the countries around them. The railway man in particular is attracted by these long stretches of navigable water on which—on the map—he sees hundreds of miles of extremely cheap extension of the zone of economic influence of his railways, once the latter have actually touched one or the other of the lakes at a single point. When studying the question, however, face to face with geographical actualities, one realizes the futility of such comparisons and hopes, as soon as the difference is perceived. While the North American lakes are surrounded by country which slopes gently towards the water-filled depression, thus affording ample opportunity not only for human settlement and industry in the immediate and wider vicinity of their shores, but also easy access from distant inland areas, our African rift-valley lakes and especially Nyasa (though Tanganyika is not much better) lack all these advantages. Their steep slopes leave little room for settlement along the coast, and communication with the surrounding high plateau country is, if at all, possible only by difficult and circuitous routes.

To return to the great plateau-block of Uhehe-Ubena, whose eastern edge we have followed as far south as the Ruhuje. Immediately to the south of that river a long and high spur of the plateau, jutting out in a south-west–north-east direction, forms a very distinct mountain range, 60 km. long, 40 to 50 km. wide at its base, and rising to an average

height of 1300 to 1400 m. This Pitu Range, as I will call it from its chief river, which has so far appeared on no map, thus joins the outlying mountain group of Mahenge (always up to now described as a *horst*, or an isolated mountain island) to the main plateau. There is no trace of the wide open valley of the Pitu which the topography as depicted on even the latest maps led one to expect. The river is there right enough, but its middle course is a narrow tortuous transverse valley, assuming in its central portion the form of a veritable gorge by which the Pitu Range is pierced. Thus—and this is an important point—that range does *not* form the divide between the Rufiji and the Nyasa–Zambezi as its general trend and altitude might suggest. The actual divide lies somewhat to the south of the south-eastern foot of the range, in a geologically much younger formation, and with a pass only just over 900 m. above sea-level to which the Pitu valley forms an easy graded access. The descent from this low divide into the Ruhuhu depression and through it to the eastern shore of lake Nyasa is quite a feasible proposition.

The existence in this out-of-the-way corner of a typical transverse valley whose river leaves a vast east and west comparatively low-lying area of soft (probably Cretaceous) terrestrial sediments, in order to break through hard and lofty crystalline mountains in a south-north direction, is sure to alter materially some of our present conceptions of the geomorphological history of this part of Africa. It is, in my opinion, not only a very excellent proof of a considerable down-faulting which resulted in the formation of the great Kilombero plain as a huge bay between the main scarp of the plateau and the Pitu–Mahenge spur; but it shows plainly how, through this very pronounced lowering of the base-level, a former west-east drainage which gave rise to the great accumulation of Cretaceous sediments, has been partly diverted at a right angle through capture by the Pitu.

To-day this Kilombero plain is a vast mountain-framed expanse of perfectly flat alluvial lands which rise imperceptibly from about 210 m. above sea-level in the east to 270 m. in the west at the foot of the Ruhuje–Mnyera escarpment. Extremely well watered by countless permanent streams, which descend from the encircling highlands and swell the greatest East African river, that meanders sluggishly in a deep clayey bed through the endless grass-steppe, this plain has for long appealed to geographers and administrators, both British and German, as a future granary of East Africa. But a closer investigation has revealed the necessity for a far more accurate and reliable study of its soils, before a final opinion can be formed on its potential value as a cotton and rice producing area. For at present cultivation takes place only on that truly wonderfully fertile riverine and deltaic land which, in narrow strips, accompanies parts of the upper main river and all the larger tributaries. Here it forms slightly raised areas flooded annually for a

few days at highest flood by running water from which is deposited a much coarser and much more valuable silt than from the stagnating flood water that covers huge surfaces and deposits a very heavy not arable clay. The broad, flat, and very gently inclined alluvial fans which descend from the foot of the hills into the inundation area between every pair of tributaries, consist of markedly sandy loam, and are probably due partly to intermittent runnels and mainly to the great " sheet floods " so common in regions of tropical rain. These fans are to-day quite uninhabited and uncultivated.

If we now turn south-west from the low divide, we find that the young sandstone and marl plateau into which the easternmost affluents of the Ruhuhu are gradually cutting their valleys, soon gives way to a different formation. At about 35½° E. long. we enter a wide and low depression which runs due west between much higher ground, and is filled to a height of 400 to 500 m. above lake-level by hard sandstones, shales, and limestones of the Karroo formation. It is, especially in the west, a shattered area of small individual crust-blocks, where the rapid erosion of the Ruhuhu and its many tributaries is maintaining steep boulder-strewn slopes interrupted by many short stretches of gorge-like valleys.

This depression is cut through the southern narrow part of the highland plateau about midway between the north end of the lake and the Portuguese border. In the south-east one rises gradually from it to the comparatively low plateau of Ungoni, with its superimposed residual granite ridges, from which spring the source-streams of the Rovuma. In the south-west the mountain wall which closes in the depression, and which is dominated by the sheer cliffs of Namtshweya's mighty twin-pyramid, has all the aspects of a fault-scarp forming the northern edge of the fertile Matengo block; whilst the north side of the depression consists of the wild and intensely dissected escarpment by which the Ubena block slopes southward. To me there can be no doubt that this Ruhuhu depression is a feature very considerably older than the Nyasa trough by which it, together with its Karroo sediments, has obviously been intersected; and that, whether we look upon it as of tectonic (which I consider more likely) or of erosive origin, we have in it a further proof of an ancient west-east drainage.

The Ruhuhu is a fine broad river at its mouth, and a little to the north lies the beautiful and comparatively sheltered bay of Manda, framed by fine sandstone hills, the obvious and only terminus for a railway from the east. As already observed by Bornhardt (in April), I found that during the rains, owing to its colder temperature, the muddy water of the Ruhuhu disappears immediately in front of the mouth, leaving the warmer and clear water of the lake surface undisturbed. But in November, when the comparatively shallow water of the river at its lowest has approximately the same temperature as that of the lake, I

noticed a streak of brownish-yellow water reaching a good kilometre or so out into the open and being blown a good way northwards by the prevailing southerly winds.

In the north-west corner of the lake lies the open beach of Mwaya, where, at reasonable cost, sufficient shelter can be provided, and thus a port be created for the densely populated fertile and beautiful Konde Land. Thomson called this land Arcady, and so it is when it does not happen to rain! It has often been described with its carpets of luxuriant pasture, its banana groves, its exceptionally clean villages and artistically built huts, rising from the tropical plain by the lake to the almost temperate climate of Ntukuyu, from whose cosy though somewhat earthquake-shaken bungalows this finest district of the Territory is administered. But I must once more emphasize the wonderful variety of its scenic beauty, created by the juxtaposition, and in a degree by the gradual melting into one another, of two such strikingly different surface forms as the overwhelming scarp topography comparable to walls of cut emerald, and the more quiet yet in their own way equally impressive lines of the great volcanic masses. Add to this the far southern horizons with the grand sheet of blue water disappearing between the dwindling crags of its mountain barriers, and the changing lights produced on slope and valley by the continuous play of its vapours, hazy mists now, delicate streaks of cloud a little later, or, in the evening, towering cumuli of white and gold and blackish-purple, and you will readily perceive what Konde Land has in store for the lover of Nature's beauty.

Dominating the scenery from whichever side one arrives, are the graceful lines of Mount Rungwe, rising from between the sheer walls of the scarps. And this highest of the Nyasa volcanoes deserves a few remarks. The apex of what looks from the south like a beautiful cone is in reality merely the most elevated southern point of a wide crater rim, a regular somma, the remains of which form the present Rungwe chain. This somma still exists well preserved, though of uneven height on the south, east, and probably north side of the large crater, whilst the whole of its western side has been blown off. The *atrio* is well developed and just below the summit is 600 to 700 m. deep. There are two large central cones, rising to heights only little less than that of the highest point on the somma, and it is these two cones which one sees as the second and fourth elevation from Ntukuyu, the third being a high point on the north-west side of the somma. As the western part of the somma is missing, the western slope of the present massif is formed by the western slopes of the two central cones, and the atrio is drained by two deep and narrow gorges westwards. As far as just beyond the southern cone the topography as described is plainly recognizable from the summit, but beyond, as its details are partly hidden by that cone, one cannot say with certainty if the two cones actually stand in the same crater or whether the mountain consisted originally of two separate

craters which have eventually grown together, each with its one central cone.

The altitude of the so-called "Siga Mbili," the highest point, my boiling-point observations, checked by trigonometrical measurement, make 2990 m., which is nearly 200 m. less than the figure on the official map (*vide* "Note on the Altitude of Rungwe," below). The mountain had probably been ascended for the first time by Kerr-Cross in 1891. Then followed Elpons in 1898, while Goetze and Fuelleborn traversed the chain in 1899. The first to climb after the British occupation were Major A. E. Perkins and Capt. C. N. Wedge, of the King's African Rifles (in June 1922), and my wife and I reached the summit early in January this year after six hours' climbing from Ntukuyu. There are, of course, no difficulties beyond the steepness and the denseness of the bamboo on the upper slopes.

At a little more than half height, approximately at 2100 m., a large parasitic structure protrudes from the otherwise fairly even flank of the mountain in a south-easterly direction; and this unevenness, the Lusiba Crater of the 1 in 100,000 map, proves on inspection to be a twin structure consisting of two craters, not one as shown on the map: a smaller lower one, which contains an apparently permanent lake, and a much larger upper one. These craters are separated by a deep narrow valley running south-east. The upper crater is surrounded by a rim only for about two-thirds of its circumference, the remainder of its walls being formed by the slope of the main mountain, with the result that the *débris* from those slopes have succeeded in silting up the crater bottom. It therefore contains only a large swamp now, with very little open water; and the level of this swamp seems, furthermore, to have been lowered quite recently by backward erosion on the south-east slope, which has eaten a large and quite fresh gap into the crater wall at its lowest point. The lower of the twin craters, on the other hand, whose southern rim is the almost horizontal ridge so plainly visible from Ntukuyu, seems to have its whole wall still intact. Kerr-Cross's statement (*Geogr. Journ.*, **5**, 1895, p. 116) that "the lake occupies a hollow on the summit, 500 yards below the rim of the crater," is thus not quite correct.

The Nyasa–Tanganyika Plateau, the eastern portion of which belongs to the Nyasa Rift and therefore to the area under discussion, I have unfortunately not had time to visit. It is a broken-up highland which drains northwards into lake Rukwa, and south-eastwards into the Songwe River, whose valley, according to a German railway reconnaissance, would seem to afford a feasible access from lake Nyasa to Fife in N.E. Rhodesia. The available reports on this country are very contradictory, descriptions of its general aspect ranging from "paradise" to "desert." But all authors seem to be agreed that from the easternmost mountainous parts which still benefit by the moisture from the lake, the

Phot. R. W. Norton

Central Livingstone Mountains

Phot. C. Gillman

Mountain forest in Udzungwa highlands

Phot. R. W. Norton

Typical tributary of the Ruhuhu in Karroo area

Manda Bay, Lake Nyasa — *Phot. R. W. Norton*

Lake Shore, Manda Bay — *Phot. C. Gillman*

Dudy Peak

Manda Bay, Lake Nyasa — *Phot. R. W. Norton*

country westwards becomes rapidly drier and more sterile, with steppe vegetation dominating.

It is as well, at this stage, to recapitulate the outstanding orographical features of South-West Tanganyika Territory:

(1) In the main the area consists of the southwards-narrowing and most elevated part of the great East African High Plateau, into which the deep Nyasa trough is sunk.

(2) Eastwards a mighty step, 1500 to 2000 m. high, forms an effective barrier to modern communications for $3\frac{1}{2}°$ of latitude, from the Mukondokwa valley in the north, through which the Central Railway reaches the plateau, to the Ruhuhu Depression in the south. Only where about midway, the Kilombero source rivers have worn down the sheer scarp into an easier yet vigorously dissected slope, can the highland of Ubena be climbed, though not without considerable difficulty.

(3) The East African Divide, *i.e.* the watershed between the coastwise drainage of Northern East Africa (including the, at present, dischargeless eastern sunklands) and the lake-filled sunklands of the central plateau, lies throughout East Africa on this plateau itself, generally at roughly 2000 m. above sea-level.* At about 10° S. lat., however, this divide dips down in a big easterly bend to the level of only 900 to 1000 m., and then runs for some distance on the sedimentary formation of the foreland until, west of Songea and south of the Ruhuhu Depression, it reascends the archaic block of Matengo.

(4) The remarkable transverse valley of the Pitu, pierced through a high plateau-spur which terminates in the Mahenge Mountains, affords an easily graded access to the lowest point of this East African Divide from which the Pitu river springs.

(5) The low depression of the Ruhuhu drainage leads by gentle grades from the low divide to lake Nyasa.

(6) Towering above the north end of the lake, the volcanic Mporoto chain, with no pass lower than 1900 m., fills the Nyasa trough from edge to edge, thus forming a formidable obstacle to communications between Konde Land and lake Nyasa in the south and the wide open plateau-basin of the upper Ruaha.

Geology.—My geological harvest, including nearly 500 rock samples, still awaits detailed elaboration. But as I have been able to add a new traverse through hitherto geologically unexplored country, it is perhaps permissible to indicate where my observations are likely to alter the latest geological map. This traverse runs roughly along the meridian in 35° 40′ E. long. from the Ruhuje river in the north, where it crosses Scholz's route of 1913, to Songea in the south, where it meets those of Bornhardt and Dantz.

* One of the few exceptions is the comparatively low area near the southern end of the East African fault-step where, not far west of Kilimatinde, the Central Railway crosses this divide at an altitude of only 1340 m.

The section first cuts through the gneisses of the Pitu Range; and from the upper end of the Pitu gorge, right across the East African divide, and through the upper (eastern) portion of the Ruhuhu Depression it remains almost throughout on the low plateau, which consists of soft friable sandstones and marls with banks of coarse conglomerate at its base. In the north these terrestrial sediments of comparatively young (probably Lower Cretaceous) age rest inconformably against the archaic scarp which here forms the left side of the upper Pitu valley, striking south-west–north-east, *i.e.* practically in line with the Mbarika scarp farther east, from where Scholz describes similar conditions. Only at and near the Hanga–Rutukira confluence has this formation been denuded down to the upper karroo of the Ruhuhu basin. The petrographical difference between the younger friable sandstones and the hard grits and limestones of the karroo are so striking, and their influence on surface forms so obvious, that the line of contact can easily be followed in the field. The younger formation, which on the latest geological map is shown only as far as the Luwegu river (about 60 km. farther east), actually reaches west to the Lumezi valley. Petrographically it would seem that this formation closely resembles, if it is not identical with, that recently discovered across the lake in north-west Nysaland by Dr. Dixey, where it contains Dinosaurian beds.

About 20 km. south of the Hanga along the Songea road, hard limestones, typical of the uppermost karroo, crop out and lie against phyllitic schists and quartzites. These latter, after a further 10 to 15 km., give place to the archaic rocks of the southern plateau block against which they rest; to decide whether or not they are down-faulted will require extensive field work. Similar outcrops of old highly metamorphosed sediments, including iron-quartzite-schist of the itaberite type, have been observed by Dantz and myself in various localities along both the northern and southern margins of the Ruhuhu Depression. Wherever they occur they lie between the karroo and the archaic wall.

The south-west of Tanganyika Territory contains four fair-sized areas of karroo: at Ruhembe, at the foot of the great scarp about 100 km. south of Kilosa; in the Ruhuhu Depression; on the lower Kivira river near the north-west shore of Nyasa; and finally high up along the Malila scarp across the Nyasa–Rukwa Divide. From the first three coal has been reported, but only the karroo of the lower Kivira is known to contain seams of exploitable quantity and quality.

Enormous masses of high-grade magnetite crop out on the top and sides of Ligunga ridge in Upangwa, only about 50 km. due north from the Ruhuhu, and throughout the Upangwa escarpment and the southern Livingstone Mountains magnetite in small outcrops is of frequent occurrence.

With regard to more valuable minerals, above all copper, the formation of ancient schists which builds up the bulk of the Livingstone

Mountains is closely allied to the highly mineralized formations of Katanga, so that, if anywhere in Tanganyika Territory, here is the place where one might still hope for the realization of that dream of mineral wealth which permeates the brains of many. Personally, I am pessimistic.

Climate.—Although our area lies entirely within the climatic province of the south-east trade winds, which is characterized by one long rainy season lasting, generally, from the end of November to the beginning of May, it is obvious that the great changes in altitude and, in the west, the proximity of the great lake, must lead to marked local variations of climate. I will touch here only on the economically most important meteorological factor—rain. The low lands at the foot of the great scarp and the Ruhuhu Depression receive between 750 and 1000 mm. annual precipitation. On the bulk of the plateau this increases to 1500 mm. and more, while the chains of the Livingstone Mountains and the volcanic area of upper Konde Land get up to 2500 mm. of rain per annum. Lower Konde Land with more than 2500 mm. is one of the wettest corners of East Africa, and here, as well as in upper Konde Land, there is hardly a month without rain. Beyond the Mporoto chain, which is also a serious climatic barrier, in the Rukwa and upper Ruaha basins, precipitation drops suddenly to 750 mm. and less, and tropical luxuriance of vegetation dwindles into arid steppe. Remarkable in the mountainous country around the northern part of the lake is the extraordinary frequency and force of the thunderstorms, which are sometimes accompanied by hail. During my travels we had at least one—often a series of storms—every afternoon without exception from November 12 to February 25.

If thus there is a very marked difference in actual precipitation between low and high lands, the orographical peculiarity of much of the area, chiefly the close proximity of high and low due to the steep and high scarps, as well as the water-storing property of the forest vegetation on the upper slopes, render at least the marginal strips of the lowlands very well watered for East African conditions. And the sudden drop of large perennial streams descending from the plateau edges to the surrounding sunk lands represents a very noteworthy accumulation of potential water-power which may, one day, lead to intense development in a direction hardly as yet foreshadowed.

As European settlement of the Kenya type has of late been frequently advocated for the southern plateau, it seems necessary to point out a few important geographical differences. First there is that of latitude, amounting to fully 9°, which, with the altitude approximately the same, must by itself result in increased inclemency of climate. This is further aggravated by the prevailing south-east wind which, in the south summer, sweeps the eastern and central portions of Ubena as a bitter, biting, and continuous blast. But chief of all there is the steady evaporation from the great lake, from which the Kenya highlands are quite free, but which renders the western parts of the Nyasa highlands

extraordinarily damp, misty, and cloudy: fair average figures in this connection are those observed at Tandala Mission station, which show relative humidity at an annual mean of 78 per cent. with a monthly maximum of 90 per cent., and cloudiness at 67 and 78 per cent. respectively. If one adds to this the nerve and heart-affecting influence of continuous life at low atmospheric pressure, the entire absence over enormous stretches of the rolling uplands, of forest and therefore of firewood and constructional timber, and the fact that notwithstanding their altitude these highlands are by no means free from tropical enemies of men such as anopheles and spirillum tick, one must, I think, agree that the southern highlands are from a climatic point of view not exactly a settlers' paradise. That these drawbacks of climate must also affect plant-growth unfavourably goes without saying, and the fact must not be overlooked that practically throughout the more easier ploughable slopes of these highlands the land has at one time or another been under native cultivation, so that virgin soil does no longer exist, and costly artificial manuring will have to be resorted to by the European settler from the start.

Vegetation and Landscape.—Anything approaching a detailed description of vegetation types over so large an area being out of the question, I shall restrict my remarks to a few glimpses of typical scenery. And I shall attempt to show how plant-life, together with the surface forms it covers, and dependent on the changing conditions of the atmosphere, influences landscape. For the great charm of this south-west corner of Tanganyika Territory is due to the fact that landscape changes rapidly in whatever direction one marches, while over hundreds of miles both in the coastal foreland and on the peneplain of the central plateau it maintains a tiring monotony.

Take first the scarp foot, a narrow strip of rich brown soil, which carries the native villages separated by savannah forest of exceptional luxuriance. Mountainwards this merges into true mountain forest, whilst outwards, towards the great inundation plains, it soon degenerates into tree and bush steppe, and that again into open grassland. At frequent intervals permanent streams take their final leap from the lower cliffs of the scarp, and their rocky beds are shaded by giant trees, outposts of the upper forest which often accompany the narrow margin of permanent moisture far out into the steppe. In places new clearings lie thick on the middle slopes, patches of yellow amidst the sombre green. Mountain rice, which does not require irrigation, is grown here for a few seasons whilst the virgin soil lasts, and then new patches are cleared under a system of criminally wasteful husbandry which carries with it the germs of rapid desiccation. North of the Ruaha, where the population of the mountain slopes is much thicker, one can already see the result in the shape of bush and grass-covered slopes, with the last forest remnants hiding in inaccessible glens.

In the great alluvial plains, subject to long-lasting annual inundation, of which the Kilombero is a splendid example, grassland, rarely interrupted by a solitary Borassus palm, dominates the central portion of heavy clay. The gray loams of the alluvial fans are the domain of the bush and higher up of the tree steppe, which pushes out in great lobes into the sea of grass. It is a wonderful scene of African grandeur when viewed from one of the foothills, this endless flat steppe, a mosaic of green and yellow, gilt by the reflection from the evening sky, from which it is separated by the dark purple bar of encircling mountain cliffs. It is a hopeless waste of stagnating water and swamp for several months after the rains, and yet I have had camps in the Kilombero during the dry season from which my men had to walk an hour to the nearest miserable water-hole!

By a few hours' stiff climb, however, we are lifted into a different world. At about 900 m. above sea-level the xerophytic savannah forest ceases on the steep slopes of the south-west scarp. Then follows, up to approximately 1400 m. a very extensive belt of bracken, with an occasional cluster of bush or stunted trees, to my mind a natural formation and not, as is often maintained, the result of human agency. I do not, of course, deny the indisputable fact that wherever in these altitudes new forest clearings are abandoned, this quickly growing and easily spreading bracken jungle takes possession of the ground and thereby increases the total area of the bracken zone. But I do maintain that this zone has always existed as a natural plant community; and nowhere is the evidence more striking than in the Udzungwa Mountains. The natives, too, declare most emphatically that the bracken was there long before man, that it is "the work of God."

The Udzungwa rain-forest is magnificent, and in its uppermost reaches where it dissolves into isolated groves of dark verdure separated by patches of bright meadow or of the dark reddish-brown of newly tilled land, it forms a landscape of fascinating beauty. Especially when the mists of early morning bring out to perfection the relief which, near the edge, changes from the peaceful gentle valleys of sluggish plateau streams to wild erosive cirques and gorges with their tumbling waterfalls, from bold rocky eminences to stately straight-lined ridges. And from everywhere one catches glimpses of the vast sweltering Kilombero plain, 2000 m. below one's feet, which by contrast help to emphasize the loveliness, the refreshingly crisp air of this mountain scenery.

In the deeply eroded valleys and gorges of the East African "Punjab," of which the Pitu is a fair representative, the vegetation is typically xerophytic: bush steppe in the wide flat debouchures, stunted and sparse savannah of the Brachystegia (Myombo) type on the low hills which fill the main erosive depressions with a terrifying maze of topographical detail, and denser savannah on the higher slopes, where in exposed positions, even as low as 800 to 900 m., the trees are often thickly covered

with lichen. Of considerable interest is the fact that the Masuku tree (*Uapaca Kirkii*, Masukulu of Nyasaland), which in the Nyasa basin often replaces the Brachystegia in the savannah formation, crosses the low ridge of the East African Divide and only stops at the southern foot of the Pitu Range. (The tree is, however, also reported by Fuelleborn from the Uhehe plateau and Central Usagara.) The stands of this tree, whose fruit is a welcome addition to the natives' diet, resemble from a distance the groves of chestnut on the Italian slopes of the Alps, and were felt as a great relief after the long days in the Myombo. And so was the reappearance of the Borassus palm and of the few great sycamores in the valleys of the Cretaceous low plateau. But above all, as a man and more so as a surveyor, one breathed freer on emerging after days of toil from the Pitu gorge with its cataracts, its depressing slopes, its pathless wilderness, when one's eye rested again on distant horizons after the more than restricted views of a tortuous, winding bush-filled notch-valley.

Endless savannah, only rarely interrupted by a miserable native clearing, stretches far and wide east and south over the Cretaceous formation. Marching is made tedious by the deep sandy soil of the flat broad ridges and by the swamps in the trough-shaped valleys, which seem much too broad for the tiny dribbles of water that drain the low and dry divide westwards. So one is glad to approach at last Central Ungoni around Songea with its hard red residual soil, its pleasant valleys breaking from scattered granite crags and tors to form the Rovuma. It is a country of delightful wide vistas where a thick population has created that artificial and pleasing form of vegetation which is so well expressed by the word " culture-steppe."

Quite different again is the vegetation in the Ruhuhu Depression. Furthest removed from the Indian Ocean and on the leeward side of the divide, protected too, to a large extent, from the moist Nyasa winds which blow south-north, *i.e.* past the entrance of the west-east running depression, its climate is drier than elsewhere in the south-west. And the soil formed by the weathering of the karroo shales and sandstones is poor. Thus it is not surprising to find large areas covered by thorn-bush with occasional doum palms, and the savannah restricted to higher parts of the clumsy-looking sandstone ridges. The Baobab, too, which had been left behind on the Ruvu–Rufiji divide near the coast, reappears on the middle Ruhuhu, a pioneer from the steppes of the Zambezi.

Even along the many permanent rivers which descend from the bordering mountains the usual marginal forest is of very poor type, a marginal bush rather, and often that also is lacking. In the dry season such parts make one realize once more that old but ever new contrast so characteristic of the more arid mountain regions of East and Central Africa: great masses of life-spending water tossing down rocky river-beds, and only a few yards away the dead valley slopes scorched and barren But when gay with the many tints of short-lived African

spring, tints ranging from brown and orange to the brightest, freshest green, with an occasional spot of crimson foliage; great white and grey clouds above, with here and there a window into the blue sky—then this mountain-framed country of flat-topped hill and rock-floored gorge, opening out on to the blue lake and its cloud-capped western scarp, has a rare beauty of its own.

To the north of this arid land the slopes of Upangwa rise in an endless succession of chains and valleys to the southern Ubena plateau. My course lay diagonally across this most fascinating country which, so far, has never been described in geographical literature. It is well worth a description and a much closer study, not only for reasons of its intrinsic beauty, but because there I can see a land which might well carry contented white settlers. I hope to get together before long a short monograph for publication in the *Journal;* in the meantime a glance or two, taken from my diary, must suffice:

"We are camping at 1500 m. above sea-level, in the heart of Southern Upangwa. We have left far below the sandstone hills of the Ruhuhu and are screened from the blue lake, after many a parting glance on the way up, by the great towering ridges of the southern Livingstone spurs. We have risen steadily for two days and are in an enchanting land. Noble hills rising to 2000 m. shut in the pleasant and peaceful valley in which we lie. The new grass is just sprouting after the first showers, and the slopes are clad in the softest of velvety green, studded here and there with a purple cluster of budding acacias, or a white boulder, and all this green and purple and white is spanned by a brilliantly blue mountain sky. The bracing air in spite of the hot sun, the wide vistas—they all make walking and climbing most pleasurable."

"The farther we penetrate into this wonderful mountain land the more beautiful it becomes, in its spring garb, with lovely flowers to gladden the eye. One night we camped at the foot of Nyamadote, whose rocky cliffs and couloirs remind one of the Dolomites in the rosy light of the parting sun. From there a stiff climb of three hours took us up to the real highlands, by no means a plateau as yet, but markedly less dissected than the long stretch of slope we had traversed on our way up from Manda. It is a glorious country of velvety downs, with quite large patches of forest, covering a rounded knoll here or pushing a dark green tongue down a little glen there; and there are wide horizons across fine chains of hills and valleys resounding with the peaceful tinkling of cow-bells. And beyond the deep broad valley of the Luwana from where we had come, one looks on to the great chain of bluffs behind which rise the vapours of Nyasa in big towering cumuli or in creeping, sucking mists."

Through such country one gradually rises to the southern part of the plateau proper where the last dying waves of the Livingstone Mountains break down into the soft forms of the peneplain. Three types of vegetation dovetail here continuously one into the other, the dovetailing following closely the lie of the ground. On the tops of the ridges and on their

higher slopes, as well as often descending tongue-like into the uppermost valleys, grows a tree formation, evergreen and dense, which however except on the highest chains cannot, as a rule, be called otherwise than temperate mountain bush. Where this bush has been removed by human activity, and that is the case over wide areas, bracken scrub and low open bush spring up as soon as cultivation has ceased. The rest of the country is low grass steppe of the purest type, hardly interrupted by any bush or tree, and undoubtedly a natural formation, *i.e.* not the result of the removal of the forest by man. Here, where both types of open vegetation can be studied side by side, it becomes very easy to decide what is natural and what is secondary plant formation. On very rare occasions when the path dips into an exceptionally deep valley, one finds the savannah of the lower regions encroaching on the plateau vegetation, the highest limit of the savannah lying at about 1750 m. and its uppermost fringe consisting of very open and stunted stands of Uapaca and Brachystegia.

The mountain steppe, especially when framed by some rocky heights as on the Mahanga Pass and when seen in flower, reminds one very much of the meadows of the Fore Alps, and the swampy little valley of a lateral stream, the herds of cattle, the long rectangular huts of the natives perched on a slope here and there, and looking exactly like Alpine cow-huts, increase the similarity. On a short walk of an hour one morning we picked not less than eighty-eight different kinds of flowering plants, all in blossom; purple and yellow, represented by fifty-three out of the eighty-eight species, were the prevailing tints, and beautiful large irises, gladiolas, and orchids delighted our eye.

And from the last low ridges one gazes to the far horizon east and north across an uninterrupted steppe of pure low grass, over wind-swept Central Ubena.

The scenery of Konde Land I have already attempted to describe, so I will finish up with a picture of the magnificent rain-forest which covers the higher slopes of the volcanic masses north of the lake and of the Livingstone Mountains themselves. Through the wilderness of long narrow valleys, where great foaming mountain streams saw through lava ridges or wind between a multitude of small volcanic cones, through the chilly grass land in their desolate upper reaches, one enters the forest of the Mporoto chain at about 1800 m. above sea-level. On the steeper slopes this mass of verdure pushes broad tongues much farther down, forming walls of emerald and gold which in luxuriance and beauty surpass all forests I have seen elsewhere on the mountains of Tanganyika Territory. On the highest ridges thickets of bamboo become frequently interspersed with tree forest, and on Mount Rungwe the uppermost forest, between 2400 and 2750 m., is an uninterrupted belt of pure bamboo. Its undergrowth is a soft carpet of Selaginella, with large slipping cushions of sphagnum moss in the higher parts, and the few surviving trees disappear in the monotony of the bamboo shafts.

Emerging on the north side of the Mporotos from the cool dripping masses of foliage, where at every turn of the swampy path one is prepared to encounter buffalo, there is a delightful and a wonderful view. Over the half-hidden villages of the sturdy Wasafwa peasants, over their fields golden with ripening corn, their pastures dotted with large herds of cattle, sheep, and goats, one gazes into the hazy plain of the upper Ruaha, 1000 m. below, and across to the solid scarp of Usangu. And due north, across the high Ruahu–Rukwa divide, above a foreground of steppe and park-bush, rises the great steep pyramid of Mount Beya to nearly 3000 m., standing high above the corner of the scarp at the meeting-point of the three great rifts. It is of nobler forms even than Rungwe, a sunlit pointed mass of green with just a few furrows on its triangular slopes to give those lines of shadow without which there can be no harmony of light.

Fauna.—We need say only a few words on the fauna, which, taken as a whole, differs but little in its composition from that of the rest of Tanganyika Territory. The most striking feature of the area traversed is the abundance of elephant. Though they disturbed sometimes the peaceful progress of my gangs when cutting survey traverses, we soon saw in them very useful allies when we came to explore the mountain valleys, through the jungle of which marching and surveying would often have been impossible without the frequent elephant tracks. And as an engineer I admired their well-laid-out and well-maintained zig-zag paths up steep slopes and their clever utilization of the smallest topographical advantage when crossing a gorge or avoiding an obstacle Buffalo, too, abounds in many places, and with the elephant is becoming a serious hindrance to native cultivation. On the Ubena plateau big game is practically non-existent.

As to fly, it is of course risky to make definite statements based on observations during a single march, as so much in their distribution depends on seasonal changes. But it remains a fact that with very few exceptions I have never been seriously annoyed during my seven months' wanderings in the south-western area, and even the few bad days were mild compared to the real fly areas in Central and Northern Tanganyika Territory. At any rate, to the south and west of the Ruhuje I did not see a single specimen of Glossina. In the temperate rain forest of the Mporoto Mountains, on the other hand, at altitudes above 2000 m., a tsetse-like fly was common, which Mr. Swynnerton has determined as *Hæmatopota sp.* In Ukinga, high up on the Livingstone Mountains, I caught an Anopheles mosquito at 2360 m.! At the same time an epidemic of tick fever was raging throughout the highlands which was a matter of grave concern for the medical officer at Ntukuyu.

A most interesting phenomenon, already described by Elton and Sir Harry Johnston, is the Kungu fly of lake Nyasa, tiny insects belonging to the genera *Cœnis* and *Corethratus.* All along the lake pale brown clouds, often of huge dimensions, frequently appear rising from the

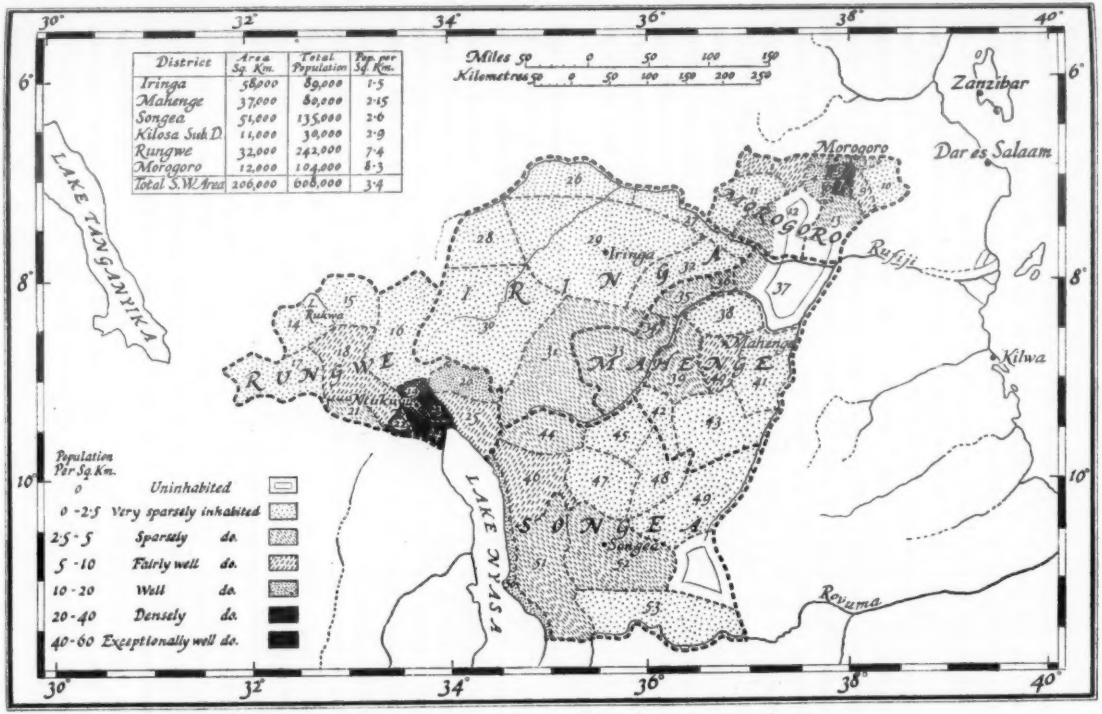
water and drifting with the wind; from a distance they look just like smoke from a steamer. They consist however of billions of these little insects, which apparently pass their larval stage in the water, whence they rise for their short sexual life of an hour or two, to be blown about and perish on water or land after their life's work has been accomplished in mid-air. A pretty native story attributes this "smoke" to an old hemp-smoker, who, having gone mad through his vice, threw himself into the lake, where he is now condemned to emit smoke clouds throughout eternity.

Population.—In these days when one hears a good deal of the "teeming millions of Africa" and of their potential productivity, it is as well to examine more closely the characteristics of human settlement in East and Central Africa. It is here that the geographer must step in to tell us if and where the realization of our hopes is likely and whether, perhaps, limitations exist to our endeavours; and to guide us in those directions where progress, based on a thorough grasp of the dominating set of interrelated geographical conditions, may be possible.

The first task is to investigate density of population; for a country or a district can be more populous than another and yet, owing to its larger size and correspondingly wider scattered population, be far less productive owing to the long distances to be overcome by the collecting agencies such as railways and roads. This is more particularly correct when production, as is the case in East Africa, means primarily agricultural production of bulky and comparatively low-valued goods. The density map* which I am showing is an attempt to give an idea of the

* The numbers in the population map refer to the following subdistricts whose names and population are given in a table on Mr. Gillman's original. It will be noted that there is some discordance between the figures given in the sketch-map for the Kilosa subdistrict and the corresponding figures in this table, but, the author having returned to Tanganyika, it has not been possible to resolve this discordance before publication.

	MOROGORO DISTRICT.	
	Subdistricts.	
1	Kilosa	21,950
2	Morogoro ..	17,700
3	Ngerengere ..	6,600
4	Mlali	13,600
5	Kinole ..	9,000
6	Mgeta ..	7,700
7	Matombo ..	13,800
8	Mtombozi ..	11,900
9	Mvuha ..	9,600
10	Kisae ..	4,500
11	Kisanga ..	5,550
12	Kidodi ..	2,700
13	Kisaki ..	9,700
	RUNGWE DISTRICT.	
	Subdistricts.	
14	Wawanda ..	3,500
15	Wawungu ..	3,500
16	Wasafwa ..	5,000
17	Wanyamwanga	6,000
18	Central Igale	42,000
19	Upper Konde	41,000
20	Wawanji ..	25,000
21	Walambia ..	6,000
22	Bandali ..	23,000
23	East Konde ..	23,000
24	Lower Konde	36,000
25	Wakinga ..	28,000
	IRINGA DISTRICT.	
	Subdistricts.	
26	Wagogo ..	3,000
27	Wasagara ..	2,400
28	Wakimbu ..	2,700
29	Wahehe ..	13,500
30	Wasangu ..	24,000
31	Wabena ..	37,600
32	Wadzungwa ..	5,400
	MAHENGE DISTRICT.	
	Subdistricts.	
33	Kiwanga west	14,630
34	Kihanzi ..	2,680
35	Ruipa	7,850
36	Ifakara ..	3,760
37	Kiberege ..	2,850
38	Luri	5,300
39	Kiwanga East	14,800
40	Central Sultanates ..	14,500
41	Eastern Sultanates ..	4,000
42	Mpepo ..	6,800
43	Mponda ..	2,600
	SONGEA DISTRICT.	
	Subdistricts.	
44	Ubena ..	9,200
45	Matumbi ..	2,300
46	Upangwa and Ukisi ..	20,000
47	Mapore ..	7,200
48	Parangu ..	4,500
49	Wadendeule ..	12,000
50	Lake Shore ..	21,500
51	Wamatengo ..	25,000
52	Zulu Wangoni	31,200
53	Warao	2,000



District	Area Sq. Km.	Total Population	Pop. per Sq. Km.
Iringa	58,000	89,000	1·5
Mahenge	37,000	80,000	2·15
Songea	51,000	135,000	2·6
Kilosa Sub D.	11,000	30,000	2·9
Rungwe	32,000	242,000	7·4
Morogoro	12,000	104,000	8·3
Total S.W. Area	206,000	608,000	3·4

Density of Population in South-West Tanganyika Territory

distribution of the population in South-West Tanganyika Territory. It is fully realized that, with none too accurate records at our disposal, such maps can, at present, be merely an approximation to the truth, but as we are here concerned with relative rather than absolute values, and as the sources of error are the same for all administrative districts, the information is sufficiently exact for purposes of comparison. The figures are based almost exclusively on the 1924 tax registers.

Taking the south-western area as a whole, its mean density of 3·4 per square kilometre lags behind the mean density (4·4) for the whole Territory by 25 per cent. And in detail we notice a distinct interdependence between water-supply and population density. The great areas of typical arid or semi-arid steppe, both of the lowlands and on the central plateau, carry less than 2·5 per square kilometre. The better-watered foot of the great scarp and the moister plateau regions of Ubena and Ungoni follow next with 2·5 to 5, while with increasing and increasingly permanent moisture, such as is afforded by the well-watered circum-Nyasa Mountains and the Mahenge and Uluguru outliers, density rapidly rises to 10, 20, and more. Only in very few and small areas where topographical and climatic conditions combine favourably, such as Konde Land, does density reach more than 40 and up to its maximum of 60 per square kilometre.

Next in importance to density itself is the fact that, however small the area over which mean density figures are worked out, these will, except in very rare cases, not represent an even distribution. For in East Africa, where the prevailing physical conditions are those of a semi-arid country, characterized by a wide-meshed network of usually only intermittent rivers and a ground-water supply deep seated and therefore not easily tapped by primitive methods, the oasis type of human settlement is general. Even in districts which, as the footlands of high scarps, are comparatively well provided with permanent streams, this type continues. Only in a few topographically most favoured mountain areas is the drainage net so closely woven that it allows of settlement more nearly approaching to that close type which is the rule in the temperate zones of the Earth or in the great deltaic flats of the tropics and sub-tropics. A point well to remember is that this semi-arid oasis type is not so much due to the lack of " agricultural " water, *i.e.* of water necessary to grow crops, such water being as a rule provided amply and at the right time by the annual rains, but that an oasis is the expression of the need for a perennial, sufficient, and reliable supply of domestic water, without which human settlement becomes impossible. Hence the ever-recurring, sad, and disappointing experience that even in fairly densely populated country narrowly circumscribed areas of settled ground, along a stream or round some water-holes, are invariably separated by wide strips of uninhabited and uncultivated land, which, however suitable soil and climate may be in other respects, cannot be

permanently settled by man owing to the absence of a permanent water-supply.

It seems to me that this very decided and geographically determined limit to an increase of population in East Africa has not, so far, been sufficiently realized. There is, indeed, one conceivable way out of the deadlock, namely, a large-scale tapping of the vast stores of deep-seated ground water and, in suitable localities, as *e.g.* the Kilombero plain, the storage of the masses of water which not only run to waste annually, but by inundating vast tracts add very considerably to the uninhabitable area. Whether the time is ripe for such enterprise, which would of necessity have to be undertaken by the State, is an administrative rather than a geographical question. In the meantime, if we wish to increase production we should look less towards increased population, but towards less wasteful methods of agriculture on the part of the existing population.

However, I do not wish to be misunderstood. For I do not maintain that wide districts of East Africa are to-day carrying their maximum of population. On the contrary, and especially in South-West Tanganyika, the most promising portions of which have not yet recovered from the appalling loss of life due to the 1905–1906 rebellion, there are plentiful signs that the population has once been much larger than at present. For this the early explorers also are witnesses. One may therefore well hope that peaceful administration for a generation or two, and the linking up of their native lands to the world's markets, will lead to an increased population and to the return of the many who are forced to-day to seek employment far away from home.

And now a short glance at the people themselves. Along the northern part of the great scarp we find a fairly thick population on the upper slopes and a string of oases along the very fertile foot. The people are mostly Wawidunda who have adopted a dual life, and by descending and reascending nearly 1000 m. daily for a good part of the year, reap crops in the hills as well as on the plain.

Further south, across the Ruaha, as well as in the eastern part of the Kilombero, we have Wabunga as the main element of the population. Their staple crop is rice. They do not make a very virile or pushing appearance, although they claim Zulu descent. From the edge of the high plateau Wahehe have of late descended some way down the slopes of the scarp, to grow mountain rice and to assist in the destruction of the forest.

Along the central and upper Kilombero and its tributaries sit likewise Wabunga, but of a much-improved type compared with that of their eastern tribesmen. On the fertile riverine land their agricultural achievements are indeed remarkable. They share the ground with the Wandamba, an amphibian people who eke out a precarious existence as fishermen, living on pile dwellings in the semi-inundated areas where they also grow rice.

The Mahenge highland is the home of the Wapogoro, admittedly one of the most backward tribes in East Africa, while opposite on the edge of the Iringa scarp are the widely scattered settlements of the Wadzungwa. These are the remains of a formerly much wider-spread people who have retired into the less accessible mountains before the raiding Wahehe.

Why the broad, wooded, and well-watered expanse of country between the Kilombero plain and the plateau edge, a series of already well-denuded fault steps, is entirely uninhabited, is a problem which still awaits an answer.

The further one penetrates into the Kilombero " Punjab," the more prominent becomes the Wabena element and with it attempts to re-stock the lowlands. Thus it is here that on a westing march one sees cattle for the first time.

On the wide Cretaceous plateau lives a very sparse population who, though they call themselves Wangoni, that is, claim Zulu descent, are in reality the remains of the conquered tribes, and do not appear to have attained to a strikingly high standard. Here it is that nearly everywhere one notices signs of former much more intensive cultivation, dating back to the days of Shabruma, the mighty Zulu chief. Hemp-smoking is to-day a serious vice in these parts.

The genuine Wangoni, round about Songea, on the other hand, are a much more hopeful race, and climate and soil of their well-watered country seem most suitable for greatly increased production. If one can rely on early German estimates, this tribe has dropped from 150,000 before the 1905 rebellion to 31,000 to-day, a deplorable fact, but one which entitles one to hope for a rapid increase under a stable administration.

Likewise most hopeful are the Wamatengo, who live on the highland overlooking Nyasa to the south of the Ruhuhu Depression, a tribe whose fertility is proverbial throughout Tanganyika Territory; and the Wanyasa, the accumulation of small tribes who form the people of the lake-shore and the coastal ranges, are agriculturists, herdsmen, fishermen, and artisans—surely many-sided accomplishments.

Upangwa and Ubena are another great area where the Zulu invasion and the rebellion have left unmistakable signs everywhere, and where there is room and water for a much-increased population. But the outstanding feature, especially in the higher parts, is the, for East Africa, uncommonly large size of the fields tilled by the individual peasant, who apparently requires not only all the skill he can command, but also expanse, to grow his annual wants in the damp and cloudy climate of these wind-swept highlands. In the west there is much cattle, whilst in the cut-up country to the east there is none. Bamboo forms one of the staple crops of these lands, exclusively grown for the sake of its sweet sap, which is tapped during the cold rainy weather when the stalks

shoot rapidly, and transformed into a very excellent though somewhat potent intoxicant.

A marked increase in density takes place immediately the wind-swept Ruhuje–Ruaha Divide is left and the ridges and valleys of the eastern Mbarali drainage entered, where there is hardly a point from which one cannot spot one or several native dwellings. What strikes one first is the very sudden change, within the limited area inhabited by one and the same tribe, of hut-form, the thatched shed-hut of the southern, eastern, and central Wabena being replaced to the north and west of the divide by the mud-covered tembe, the typical dwelling of Uhehe and many of the tribes in the great Rift Valley. In explanation of this change the Wabena told me that the reason for building the shed-huts of the former inhabitants, instead of their national tembe, is solely the unsuitability of the clay south of the divide. This is not only interesting from the ethnographical point of view, but seems to bear out my suggestion of more advanced erosive action in the Mbarali drainage, for it seems quite plausible that in the north-western area advanced transport by erosive action has in places produced a colluvial soil, *i.e.* has led to a mixture of the original soils, more waterproof and thus more suitable for roof construction, than the unmixed eluvial or residual soils found everywhere *in situ* in the Ruhuje drainage area.

Into the lower and middle Mbarali valley Wasangu from the Usangu plain have intruded, so that the population round about Kidugalo Mission station consists of Wabena and Wasangu.

Quite contrary to Thomson, who calls them degenerate, I must state that one of the sturdiest and most intelligent native tribes I have ever come across are undoubtedly the Wakinga, whose scattered villages go up to 2600 m. on the Livingstone Mountains. Surely it requires uncommon perseverance to depend on agriculture against so many odds due to an inclement climate and a most accentuated surface. Even the most incredibly steep slopes carry carefully terraced gardens. These people have readily accepted wheat and European potatoes, both of which, introduced only a generation ago by the German missionaries, form to-day the staple food. On the more protected western slopes wheat is grown down to 1700 m., where it suddenly ceases, giving place to the banana of Konde Land, while in the east 2000 m. seems to be the present lowest limit. Another interesting fact, and one well worth considering for the prospective settler, is the following: As a result of the climatic conditions the corn ripens very unevenly, a drawback which is easily coped with on the small fields of the native peasant by daily picking of the ripe ears, but which will never do for the large fields of the European settler, who must, obviously, be able to rely on quick and simultaneous harvesting of his crop.

Cattle in Ukinga are very healthy, and to my lay mind sheep-running, in Ukinga as well as in Ubena, should be encouraged. In fact, I believe

that in the direction of large-scale wool production lies the future development of this beautiful mountain land and its very hopeful inhabitants.

In Konde Land, and there alone, does one at last see really close surface settlement. The present inhabitants, the Wanyakyusa (the Wakonde having long since been driven south across the Songwe), are a prolific, healthy, and highly intelligent race with a standard of autochthonous civilization surpassing that of all other tribes in Tanganyika Territory. Scrupulous cleanliness of body, hut, and stable; a high social standing of their women, who do not assist in the tilling of the soil; the growing of timber and bamboo for structural purposes; and a markedly advanced architectural art, are some of their more striking accomplishments. Here, if anywhere, is a tribe which can be relied upon to respond to efforts directed towards increasing their prosperity and well-being. The present staple food is the banana, but rice and probably cotton in lower, and ground-nuts in upper, Konde have a good future. And between these two divisions where a broad belt of virgin woodland covers rich volcanic soil, one can visualize quite a number of white settlers who might produce coffee and probably tea. Cattle are plentiful, splendidly cared for, and of good quality.

If we may trust German official estimates of 1904 it would seem that in Konde Land, which not only did not suffer from the 1904 rebellion, but very likely received an influx of population from the more disturbed areas on the high plateau, we have a record of a gratifying increase. For while in 1904 the total population of lower and upper Konde Land is given as 63,000, the 1925 estimate by our District Officer, based on tax registers, is 100,000, *i.e.* an increase in twenty years of over 50 per cent.

The northern slopes of the Mporoto chain and the plains at its foot are inhabited by the Wasafwa. These are great agriculturists, and their large fields, mostly of maize, are astonishing and remind one of the culture steppe of Usukuma and the Mwanza area. They keep very large herds of healthy cattle. However the population, nowhere very dense, soon dwindles, as towards the west and north-east the steppe character of the country becomes more pronounced.

I have endeavoured to give a rough outline sketch of a land full of beauty, full of hopeful possibilities, and above all of a land inhabited by nearly three-quarters of a million souls who at present are doomed to unproductive stagnation owing to their remoteness from the pulse of commerce and industry. I have purposely laid stress on the difficulties of topography, climate, and population, not because I hold them insuperable, but because I believe that facing facts is preferable to mere hopefulness. But once more I must insist on the necessity for much more thorough and detailed regional surveys by fully qualified specialists under the guidance of a geographer. Such surveys alone can show us the right path, can keep us from trespassing against the laws of nature and from erring in our judgment of the human material at our disposal.

And, incidentally, by teaching us the history of one of the oldest bits of its crust, such surveys will shed new and badly needed light on the evolution of the Earth's surface.

NOTE ON THE ALTITUDE OF MOUNT RUNGWE

Probably the first estimate of the height of Rungwe is Kerr-Cross's (*Geogr. Journal*, 1895, p. 116), who calls it "fully 9000 feet."

On 10 October 1896 Bornhardt (*Zur Oberflächengestaltung und Geologie von Deutsch Ost Afrika* (Berlin, 1900), p. 171) determined the height trigonometrically from Rungwe Mission, the altitude of which he had made 1490 m. by boiling-point. He arrives at 3120 m. for Rungwe summit, but there seems to be something wrong with his computation. For, taking his angle of 8° 50′, and the horizontal distance from Trotha's 1913 map on 1/100,000 at 9·5 kms., and allowing 10 m. for refraction, the difference in height between mission and summit would be 1486 and not 1620 m. as given by Bornhardt. And if one reduces the level of Lake Nyasa on which B.'s determination of Rungwe Mission was based, from his assumed figure of 500 m. to 471 (*i.e.* the most recent figure as incorporated on the latest, 1919, sheet of our 1/2 M map, and one which my recent survey fully confirms), Rungwe summit would be 2967 m. On his own map Bornhardt shows v. Elpons' height.

This latter, a German official, observed the boiling-point on 16 August 1898 at 3.15 p.m., making it 90·15° Centigrade with an air temperature of 15·5° C.G. (vide *Deutsches Kolonialblatt*, 1898, p. 794). From this the altitude was computed at 3175 m. This is the figure which has been retained to this day on all maps, and it is also given in Krenkel's *Geologie Afrikas* (p. 269), a book published in 1925.

It seems to me not unlikely that v. Elpons made a mistake of ½° Centigrade when reading his thermometer, a mistake frequently made by laymen not accustomed to the use of instruments. Such a mistake would just about account for the discrepancy of v. Elpons' height, as ½° more than his 90·15° would correspond to approximately 538 mm. of air pressure, *i.e.* would tally well with Goetze's aneroid readings (quoted by Kohlschuetter, p. 222) in September and October 1899, of 537·5, 538·4, and 536·1 mm. respectively, as also with my own boiling-point observation of 537·8 mm.

The retention of Elpons' figure is all the more surprising as Kohlschuetter's very careful work during the East African Pendulum Expedition of 1899 and 1900 has been published as long ago as 1907 (*Ergebnisse der Ost Afrikanischen Pendel Expedition der koenigl. Gesellschaft der Wissenschaften zu Goettingen*, Berlin, 1907). Based on the trigonometrical altitudes of the British–German Boundary Commission between lakes Tanganyika and Nyasa, Kohlschuetter gives the trigonometrically determined height of Rungwe summit as 2977 m., with Nyasa level at 477 m. (pp. 150, 208). This would make 2971 m. with lake level at 471.

Fuelleborn (*Das Deutsche Nyasa und Rovuma Gebiet* (Berlin, 1906), pp. 275–6) adopts Kohlschuetter's preliminary computation of approximately 2950 m.

My own observations were made at 9 a.m. on 3 January 1926. The boiling-point, determined by two Fuess instruments graded in millimetres of air pressure, gave 537·8 mm., with air temperature at 12° C.G., and was checked by a Casella Aneroid (No. 10,499), whose behaviour and corrections were well known after five months' continuous use in the field. The computation was based on Ntukuyu Government station (Boma yard), the altitude of which,

referred to Nyasa lake level of 471, is correctly known to be 1555 m. At Ntukuyu the boiling-point was determined before and after the ascent (at 17 h. on the 1st, and at 9 h. on January 4), and the daily variation curve had been established on December 23, January 1, and February 1 and 9, with variations between 9 h. and 17 h. of —2·9, —2·7, —2·7 and —2·6 mm. respectively. The mean between Ntukuyu–Rungwe (1427) and Rungwe–Ntukuyu (1435) works out at 1431, which added to 1555 gives 2986 for Rungwe summit.

A trigonometrical check with a mean angle of 5° 57′, a distance of 13,700 m. (from Trotha's 1/100,000 map) and 13 m. for refraction, gave 2996 m.

One can thus safely assume that the altitude of the Siga Mbili summit of Rungwe lies somewhere between 2970 and 3000 m., *i.e.* it is nearly 200 m. less than that shown on all official maps.

Before the paper the PRESIDENT (Dr. D. G. HOGARTH) said: This evening we are to be instructed about that great territory—the largest, I think, that accrued to any of the belligerents after the war—the territory of Tanganyika, which formerly was German East Africa. Some of those present this evening will remember Major Church speaking about it in connection with the Government Commission, of which he was a member. You will remember that he spoke of the great necessity for more knowledge, and that has been again and again emphasized by his chief, Mr. Ormsby Gore, the Under-Secretary for the Colonies—the need for more knowledge of a country which we have now held under mandate for seven years and which has been little longer than that under our occupation. Well, we are going to hear an instalment of that necessary knowledge; or, at any rate, we are to have an indication of the very considerable instalment of the requisite knowledge which has been put at the disposal of the administrators of the country. It is to be given by Mr. Gillman, who will be remembered as having given us a very interesting paper upon Kilimanjaro four years ago. He has been for some years senior district engineer of the Tanganyika Railways, and in the course of his professional duties, and I fancy to some extent outside his professional duties, he has quartered the country in almost every direction. No one is better aware than he is that single exploration like that is not equal in value to exploration by a trained and organized body of explorers traversing a country methodically. But, as I understand that the loan from the Government of which Major Church spoke to you, although it has not actually been paid, has already been spent in the country, we may hope that more organized exploration will follow. But so far as it has gone Mr. Gillman's exploration seems to me to be of the utmost value, because he is admirably well qualified in many scientific ways to be a pioneer. However, you shall judge for yourselves, and I will ask him now to give his lecture upon South-West Tanganyika Territory.

Mr. Gillman then read the paper printed above, and a discussion followed.

Major-General Sir EDWARD NORTHEY: I think you will appreciate that I could, in spite of the lateness of the hour, talk for a long time, because this particular part of the world happens to include precisely the whole of the country over which I took my troops and which I administered during the last three years of the war. First of all, I would like to congratulate the lecturer, and also the gentleman who apparently prompted him to give this paper, by enunciating that railway engineers, when surveying land for the purpose of finding where a railway may go, do not look at anything else. We can congratulate the lecturer on the fact that he did look at something else, absorbed

it, and reproduced it for us to-night. He commenced and ended his remarks by rubbing into us the importance of such regional surveys being made and properly coordinated. I entirely agree with him. I think that many of us have been open to criticism in not being sufficiently long-sighted in these matters. At the same time, I must put it to you that when a Colonial Governor brings a budget forward, with any sort of opposition, you probably find, if something has to go out because people are clamouring for more money for, say, education or agriculture, that the majority are less interested in survey, and cut the estimate for it down: that possibly accounts for what looks like lack of foresight in this matter in Colonial Governments.

Vividly as the lecturer has described it to you, I think that it would be extraordinarily difficult for anybody to give you an idea of the beauty of that country: it is certainly the most lovely part of Tanganyika Territory. I think probably it would be easy for you to sympathize with me when I tell you that when I went up Lake Nyasa with the Nyasa–Rhodesian troops, that country which you have heard described to-night was in front of me, with the enemy in it, and I had to make roads and get my troops through that country, across those rivers, and over those mountains. Not only is the country as beautiful as he has described it, but I agree with what he has said about the natives. There is only one point on which I join issue with him, to a certain extent. I think he is right to give warning with regard to settlement of any sort in that country. But I think there is ample room for white settlement in that part of the country, and I believe, looking to the future and to the possibilities of the whole of East Africa, that it would be a great thing, from an Empire point of view, to encourage such settlement. I do not know what the ideas of the present administration are. I give you only my own opinion after living three years there. I believe that that part of the world, exactly as has been proved farther north in Kenya, is most suitable, and that it would be in the interests of the country, and the natives, to have the dual system; that is to say, a certain number of well-selected white settlers living on the lands which do not belong to anybody and are unoccupied.

The particular part of the country I have in mind is from Dodoma, down through Iringa, towards Tukuyu and Fife. Though the lecturer has been surveying that country from the point of view of railway development he did not tell us where the railways should go. Having had to make roads through it and study it, my own opinion is that the best way to develop that country—and there are enormous possibilities, for you can grow anything at the different altitudes and in the different soils—would be to bring a railway down from Dodoma, through Iringa, to Tukuyu and thence on to Fife. With regard to the Kilombero basin, I believe from what I saw that an enormous quantity of rice could be grown there, as it has been in the past.

I should like to corroborate another remark the lecturer made: that is, that eastwards from Njombe to Lupembe, south of Iringa, it is extraordinary to see the wonderful richness of the country. For miles there are nothing but places in which there have been old native gardens, all now deserted. James Sutherland, the elephant hunter, who was on my staff during the war, fought with the Germans in the great rebellion. He told me that 80,000 natives were wiped out in this particular neighbourhood.

The lecturer spoke of the rainfall in Mporoto Mountains. The rainfall is sufficient, the altitude and, I think, the soil of the right sort to grow tea; and everywhere at about 6000 feet it would be possible to grow good coffee. I believe if in the future that part of the world is properly developed, and the

communications, as I think they will be shortly, taken in hand, it has enormous possibilities. I think that there should be a British white population, and there need not be much fear, if we carry on on those lines, of the mandate ever being anything but British, as it should remain.

Sir WILLIAM GOWERS (Governor of Uganda): I feel signally ill qualified to speak after Sir Edward Northey, for to him we owe it that we now hold that part of the country shown on the map, which I have been particularly pleased to see, and which was dealt with in the very interesting paper we have heard to-night.

One of the things that impressed me was the very keen appreciation that Mr. Gillman has of the scenery of Africa, especially the wonderful scenery of the Rift Valley of East Africa. I think he feels, as I feel, that one of the principal things that enables one to go on living contentedly for many years in tropical Africa is an appreciation of its scenery. I do not know whether he feels as I do, but others have agreed with me, that what appeals most in Africa is some piece of scenery which reminds us of England, or Scotland, or Ireland. Conversely, when in those countries I often say, "That is just like a bit of Africa," and like it the better for that reason.

Unfortunately, I am as yet entirely ignorant of the part of the country that has been described. I belong to a neighbouring and, I hope, friendly State. In any case, although the country I represent and the country with which we are closely allied, Kenya, did have a little friendly argument about the development of the country in the north of Tanganyika Territory, it has none about the development of the country in the south-west. If you have ever read the possibly very tedious proceedings at a certain conference of Governors held in Nairobi last year you will see we all agreed that a railway should be built from Dar es Salaam to the south-western highlands of Tanganyika.

The country described to-night has, of course, also historical importance as great—I will not say greater—than Nairobi, in that the first unofficial conference was held at Tukuyu by the representatives of European settlement in the East African territories. I think that Tukuyu may become as famous in future African history as perhaps Runnymede.

There is one point that I should like to raise in order to elicit some information. I should like very much to know what is the height at which the tsetse fly and Anopheles mosquito respectively are found. I read in the paper that Mr. Gillman had seen the Anopheles mosquito at something like 7500 feet. Personally I have seen tsetse fly at something over 4000 feet—never any higher. I have seen Anopheles mosquitoes at about 6000 feet, but I am not certain I have seen them any higher.

One other word. Would it not be a little kinder to some of us who are not eminent mathematicians if we could be spoken to, especially as regards figures of density of population, in square miles rather than in the metric system? In conclusion, I express my great gratitude for the particularly interesting and informative paper that we have heard, and I hope one day I shall be able to visit the wonderful scenery which Mr. Gillman has described, possibly by means of the railway the location for which he has been prospecting.

Sir HALFORD MACKINDER: If the Governor of Uganda was a little timid of speaking of this territory, which is neighbour to his small kingdom, how much more ought I to be so, in view of the fact that my experience is removed not merely by a considerable distance of miles from Tanganyika, but now also by a considerable distance of years! The problems which it is my

duty to consider to-day concern the Empire as a whole, and it occurs to me to suggest to you that this particular region has become, as the result of the war, one of the vitally important spots in the structure of the British Empire, for the British Empire to-day has a structure. It does not consist merely of a number of territories scattered over the globe. There is a northern belt: Great Britain, Ireland, Newfoundland, and Canada. There was a time when the Romans doubted whether Scotland was habitable for decently civilized people. It is not very long since it was doubted whether any large portions of Canada beyond the St. Lawrence Valley were suitable for white civilization. There, then, is one great zone. The other main belt of the British Empire lies round the Indian Ocean. It starts from the Cape and goes to the Canal, with territories in various degrees of *liaison* with the British Empire; it extends across Northern Arabia and through the Persian Gulf; it is continued in the vast Empire of India; then comes that very wealthy patch on the world map, not in fact so very small, of British Malaya; finally you have the island continent of Australia. So we see a vast arch, spanning the Indian Ocean, with India as the keystone. We have returned to-day to the position that the British Fleet is principally stationed in the Mediterranean. Why? In order that it may go through the Straits of Gibraltar on the one side, if wanted, into the North Atlantic; and in order that it may go through the Suez Canal, if wanted, into the Indian Ocean.

But, as the result of the war, the vastest of all these great territories is that which starts at the Cape, goes continuously up all the east side of Africa, and crosses through the root of Arabia right up to the borders of Persia. Canada is 3000 miles across; Australia is a little less; India is some 1500 miles long, but South and East Africa and Arabia are 6000 miles long. In that region are the Cape and the Canal. The neighbourhood of the Canal is the Charing Cross not only of the shipping world but also of the air world which is coming. Do you realize what will probably be the airship track to Australia? Quite likely through the Mediterranean and down the Red Sea; then across the eastern horn of Africa and down the east coast to Durban; and then on the west winds right across the Southern Ocean to Australia. The return flight would be rather farther to the north, across the Indian Ocean to the east coast of Africa, perhaps to Mombasa, and thence northward and up the Red Sea.

Now consider East Africa from another point of view. There are two parts of the world where there is high ground under the Equator, where white men can settle and link together the white worlds of the north and the south. The one is in South America; the other is in Africa. It is of vast importance, if it be possible, to settle a series of white communities, in relation to the surrounding native populations—they can only be aristocracies, but complete white communities, men, women and children—on this chain of uplands from Kenya, through Tanganyika, into Northern Rhodesia. They will uphold a standard for the civilization slowly growing in the districts around, and will secure British communications in this all-important region. Although it may not be full of wealth, not wealthy like the plains of Argentina, not perhaps with the wealth of the Rand of South Africa, yet none the less it is a region full of beautiful scenery and, in well-chosen areas, with the climate and soil that are needed. There is probably room for a chain of small but very important white communities. I venture to say, therefore, that the close exploration and survey of this region, and the work that is being done in it by such tropical seats of investigation as the Amani Institute, are very significant.

That things are taking place is evident. One hundred pounds' worth of butter from Kenya was put upon the London market during the past summer!

I do not hold out the idea that you are going to see many millions—a new Australia, a new Canada—in that region; but you may see what I venture to call a row of white aristocracies amid the native populations of Africa, extending northward from the Union of South Africa, across the Equator, linking up with the Nile, and by sea traffic, railway traffic, and air traffic with Egypt and Palestine, the focus of the communications of this extraordinary and unparalleled Empire.

Major G. ORDE-BROWNE: There is one brief point that I should like to make in regard to the lecturer's remarks, and that is the extreme importance of the population map he showed. If we are to have a chain of white aristocracies, these aristocracies will require servants and labour, and it is a very serious problem where that labour is coming from. Mr. Gillman referred to the value of the natives in that part, particularly the Wanyakyusa, and I have no doubt that he is perfectly justified in his description of them. Nevertheless, the fact remains that when those same Wanyakyusa leave their own country and go to work on the Central Railways, as they do in small numbers, they are universally regarded as almost the worst labourers in Tanganyika owing to the extent to which they go sick and to what is usually described as their lethargy. Personally, I think it is due to change of climate and food. I only refer to it as illustration of the difficulties we are going to have over labour questions. There is also the question of spirillum fever. Mr. Gillman referred to the prevalence of ticks, and I am sure he will bear me out when I say they are a perfect curse over a large part of that country. We shall undoubtedly have imported labour in view of the sparseness of the population there. Anybody who has dealt with African labour knows how liable natives are to panic, especially in cases of sickness, and I am sure there is risk that we shall find that this imported labour suffers from a variety of sickness, and that if the natives get panic-stricken the area will get a bad name and we shall be faced with real labour difficulties.

There is also the question of the extraordinary roughness of the country as shown by the very striking photographs we have seen this evening, which in itself will, I suppose, although I do not speak with any technical knowledge, introduce great difficulties in the matter of real reconnaissance and development. I would venture to plead for a continual parallel development in the direction of medical research and cognate matters when we are thinking of any questions of regional survey. Unless we have some idea of the difficulties arising from disease or other sources that we are likely to meet, we run a very definite risk by advocating development which may meet with unforeseen disaster.

Mr. C. GILLMAN, in replying, said: I realize it is somewhat late, but a number of points have been raised. May I take Major Orde-Browne first? The question of medical research is rather close to my heart, and I have always regarded it as an essential part of any regional survey. As to European settlement, I consider it my duty before a geographical audience to point out what I perceive to be the difficulty, and, chief of all, that between the wonderful area of white settlement in Kenya and this new area. There are great difficulties on account of topography and climate, and, far from trying to advise against settling in that part, I was only attempting to point out that we require more accurate and intimate surveys from every point of view before we can advise an "aristocracy" to go out there and risk their family, their money, and

everything else. Sir Halford Mackinder rightly mentioned women and children. For what we want is settlers; that is to say, people who will go there and consider the country their own. But in order to do that they must live and be able to rear and bring up children. We want the doctors to tell us whether that is possible. I think we ought to take every opportunity of mentioning this and trying to induce the powers that be to help us to find out what is right and what is wanted. But we all hope that the medical officers and discoverers will say eventually, "Send out your aristocratic settlers into those lands." I think we who have been there and seen the tremendous difficulties ought to refer to them in public whenever we get a chance.

As to the railways. I have deliberately refrained from saying anything in regard to the railways, first of all, because I happen to be on furlough, and secondly, because the question of railway policy out there is by no means settled, and I am not very well able to say what I think. Therefore I hope you will forgive me if I do not reply to General Northey. All I tried to do was to give you, as geographers, what those interested in geography look for—a description of the topography and the economic features of the country; and I thought that thereby you would be able to form your own opinion on the advisability of the one line or the other. That is why I left out railways entirely.

As to tsetse and Anopheles, you will find some additional notes in my paper which I had not time to read, and I fully endorse Sir William Gowers' remarks on the advisability of ascertaining to what altitudes these little beasts really go. As to millimetres and square miles, as the President told you, I am working for the Tanganyika Railways, and as we have taken over those railways which were largely built by the Germans, we had to take over their mileage, which was in kilometres, their whole system being metric. Besides, the latest sheets ot the General Staff 1/2 Million Map of Africa now also show contours and heights in metres. General Northey referred to the roads which he built in the days of the war, and I should like to express my thanks for those very excellent roads which are still in existence, and which have helped me and my caravan very considerably in our efforts to survey as much as possible of the country.

The PRESIDENT: We have had an exceptionally interesting evening, and I think our gratitude is due not only to the protagonist but also to those who followed him. It has been very interesting to hear such a discussion opened by the original conqueror of the country and ended by Major Orde-Browne, who has to deal with its future. As everybody knows, the labour problem throughout this newly acquired territory and also our own colony is the most difficult which South Africa has to face. But our gratitude is due, in chief, to Mr. Gillman, and I hope you will follow his advice and read his paper carefully when it appears in the *Journal*, for he left out a very great deal of it. In particular, he left out most of that science in which he is peculiarly competent—the science of geology. I suppose he thought you might easily have too much of "faults" and "strikes," even if the latter are not of the type with which we have become too familiar recently! Therefore he left out a great deal of what is essential to the understanding of the geography of the country. When you come to read the paper you will see how very large an instalment has been contributed to that knowledge, which we all know to be so essential, of this newly acquired territory, and I hope you will signify your gratitude to Mr. Gillman.

ANCIENT SURVEYING INSTRUMENTS

Col. Sir Henry Lyons, F.R.S., Director of the Science Museum

Read at the Afternoon Meeting of the Society, 13 December 1926.

AT the Science Museum in South Kensington it is the practice to illustrate the early stages of any science or industry which dates from ancient times by a few examples selected from such instruments or apparatus as were in use by early civilizations, and in doing this the Museum has acquired examples or copies of some which may be of interest to surveyors and geographers.

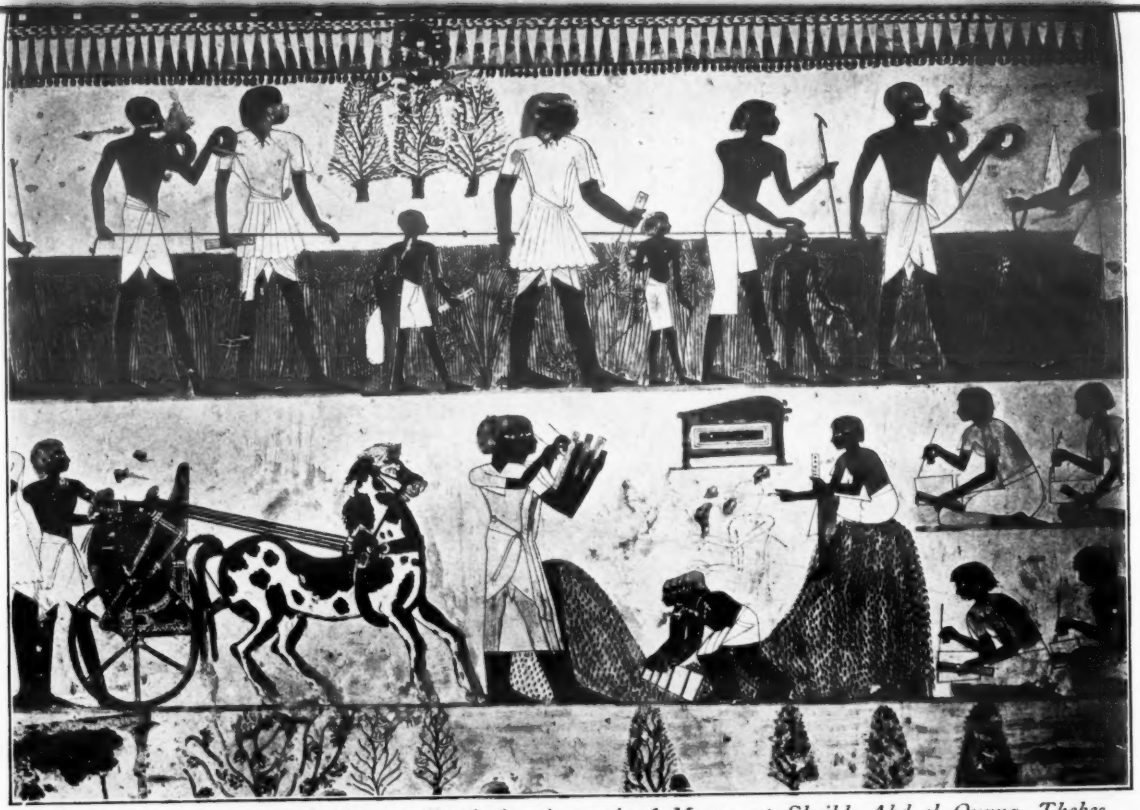
The instruments which were necessary for measuring land in the early stages of man's civilization were certainly of the simplest type: a unit of length derived from a part of the human body, such as the forearm or the foot, determined the length of the rod or cord with which pieces of land could be measured, and for a long time these would be of no great size. They would belong to agricultural communities settled in fertile areas, such as the alluvial plain of a great river valley where the need of measurement to delimit and to locate the holdings would be soonest felt. The valleys of the Nile and the Euphrates were the scenes of the earliest civilizations, and their level plains were eminently suited to the simple technique of land measurement which developed there. It is not surprising that but few of these simple instruments have survived, for they were easily prepared and replaced when worn out or lost, and so were of little value.

In Egypt we find records of measurement from very early times, for on the Palermo Stone, which is now in the Museum at Palermo and bears a record of the royal annals of the Old Kingdom, river gauge readings occur and " numbering of gold and lands " is recorded as taking place in the reign of an unknown king of the II. Dynasty (*circa* 3000 B.C.).

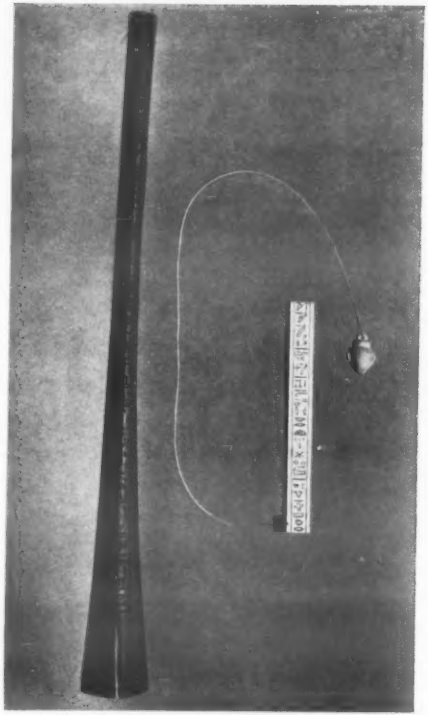
Such a " numbering " of the royal possessions made every two years throughout the land by the officials of the Treasury, would be a sort of verificatory survey of State property which doubtless included herds as well as land, and this biennial census was so regular a procedure of the administration in these early times that events in the reign of the king were dated with reference to it.

A little later we meet with evidence of the registration of property, for about 3000 B.C. the property of a high official, Methen,* who lived under the third dynasty, was recorded on the walls of his tomb at Saqqara, where it is stated to have been duly registered as belonging to him in the royal archives or registry. At this time therefore there must have been a well-developed method of measuring the land and of computing the area of properties, while the registration of land and its measurement

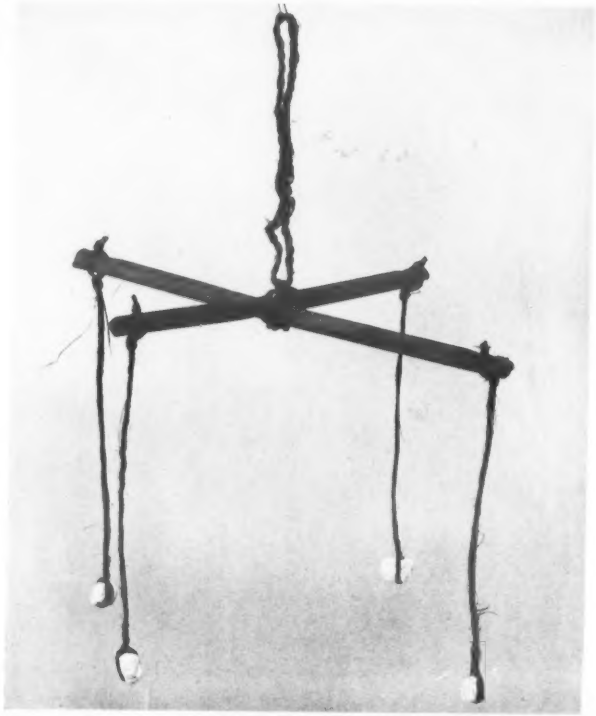
* Breasted, ' Ancient Records ' (Chicago), pp. 171–5.



Land-Measurers at work, from wall-painting in tomb of Menna at Sheikh Abd el Qurna, Thebes



The Merkhet of Ancient Egypt



Groma from the Fayum : suspension and weights restored

was becoming highly organized, as being essential in a country where all payments of taxes were made in kind and rent was paid in the same way.

Another tomb at Saqqara, that of a certain Mes,* furnishes us with information of exceptional interest. Certain lands near Memphis, which the Pharaoh Amosis (1580 B.C.) had conferred on an ancestor of Mes named Neshi, were, during the minority of Mes, claimed by a certain Khay as his property. A lawsuit followed in which Khay produced false title-deeds, whereupon Nubnofret, the mother of Mes, appealed to the official registers, saying, "Let there be brought to me the registers from the Treasury and likewise from the Department of the Granary of Pharaoh." A commission was sent by the court to make extracts from the registers, but by means of falsified copies Khay gained his case; he was, however, non-suited on appeal when the evidence of many neighbouring landowners was taken.

No map of landed property in ancient Egypt has come down to us, but on the tomb walls we meet with representations of land-measurers at work, and their methods are shown on the walls of the tomb of one Menna † at Thebes, a land overseer and inspector of the boundary stones of Amon. The tomb, which is situated in that portion of the Theban burial-ground known as Sheikh Abd el Qurna, was cleared out by Mr. R. Mond a few years ago. The scene depicted shows two chainmen measuring a field of corn with a long cord on which are knots or marks at intervals which seem to be about 4 or 5 cubits in length; each also carries a spare cord coiled up on his arm. Beside them walk three officials, who carry writing-materials and who are accompanied by a small boy carrying writing-materials and a bag in which are probably documents and plans referring to the property. An old man and two boys also accompany the surveyors, and a peasant brings a loaf of bread and a bunch of green corn.

A similar scene is pictured on the walls of a tomb belonging to a certain Amenhotep, also at Sheikh Abd el Qurna, where it is possible to see that the cord terminated in a ram's head. This is also shown on the statue of the priest Pa-en-hor from Abydos, which is now in the Cairo Museum; he is represented in a kneeling position and is holding a rolled-up measuring-cord, at each end of which is a ram's head, showing that he was an official of the temple of Amon-Ra.

The rich harvest of papyri dating from Ptolemaic and Roman times which have been recovered from ancient sites in the Fayum and elsewhere in Egypt in recent years furnishes much valuable and interesting information concerning the measurement of land, its registration, its quality, and many other matters of a similar character.

A particularly complete collection of official papers from the bureau of Menchis, the komogrammateus, or government scribe, of Kerkeosiris,

* Loret, 'Zeitschrift für Ægyptische Sprache,' 39 (1901). Moret, *ibid.*

† Borchardt, 'Zeitschrift für Ægyptische Sprache' (1905), p. 70.

close to Tebtunis, was found in 1899–1900 by Professor Grenfell and Dr. Hunt when they were excavating the site known as Um el Baragat, the ancient Tebtunis, on the south side of Gharaq in the Fayum, and was published by them in 1902. The papyri date from about 120–111 B.C., and deal largely with land measurement, land registration, and kindred subjects.

The village of Kerkeosiris, to which many of them refer, contained 4700 arouræ, or about 3100 acres of land, which in the fifty-second year of Ptolemy Euergetes II. (119–118 B.C.) were distributed in seven different categories. Another papyrus from Tebtunis gives a detailed description of certain small plots of land on the east side of Crocodilopolis Arsinoe (Medinet el Fayum), between the road round the town and a large canal. The dimensions are given in schœnia, and the plots are of the usual small size; some belong to private individuals, one belongs to the queen, another is recorded as common land, while a public road between the private property and a public canal is separately registered. The same conditions may be exactly paralleled round Medinet al Fayum to-day.

From early times the marking out of the province boundaries was recognized as being of great importance, and the inscribed stelæ which were placed on the limestone cliffs on either side of the valley in order to define them in a permanent manner, have in some cases been preserved until the present time. In the eighteenth dynasty King Ikhnaton set up such stelæ on both sides of the Nile Valley in order to delimit the district of his new capital, and the position of fourteen of them are known with more or less accuracy to-day, eleven being on the east side of the river and three on the west. In the inscription the length of the district is defined as follows: "from the southern mark as far as the north mark measured between mark and mark on the east mountain of Akhetaton (the town) amounting to 6 iter $\frac{1}{2}$ and $\frac{1}{4}$ of a khet and 4 cubits. Likewise from the south-west mark of Akhenaton to the north-west mark on the west mountain of Akhenaton amounting to 6 ater $\frac{1}{2}$ and $\frac{1}{4}$ of a khet and 4 cubits; and the area within these four marks, from the east mountain to the west mountain of Akhenaton . . . opposite, it belongs to my father Aton. . . ." * From the boundary marks which still remain it is possible to form some idea of what the Egyptians could accomplish in the measurement of long distances in the fourteenth century B.C.

In 1909 Mr. C. F. Montagu of the Survey of Egypt † connected the northern and southern boundary marks on both sides of the Nile Valley with the Survey triangulation. The distance between the north and south marks on the eastern hills was found to be 15,075 metres, while that between the corresponding marks on the western hills was 15,021 metres. In the latter case the southern mark has now disappeared, and there is

* Breasted, 'Ancient Records' (Chicago, 1906), 3, p. 398.
† Montagu, *Cairo Scientific Journal*, 1909, p. 80.

some uncertainty as to its original position and therefore about the length, but it is clear that they were able to lay out and measure distances of this size with a very creditable accuracy. They undertook the task of laying out two lines of equal length about 15 kilometres in length and from 20 to 25 kilometres apart on the intersected margin of the limestone plateau on either side of the Nile Valley, and carried it out with a very considerable measure of success. So far as we know, they had only their measuring cords and rods and the merkhet or plumb-line to aid them.

In the case of buildings a higher accuracy could of course be attained though the methods and instruments employed were doubtless the same as in the field, namely the cord and the rod. As an example of the accuracy to which the Egyptians attained early in the third millennium B.C. we may take the Pyramid of Khufu (Cheops) near Giza, which has been recently remeasured by the Survey of Egypt.* The length of the four sides were found to be:

North side	230·253 metres
South side	230·454 ,,
East side	230·391 ,,
West side	230·357 ,,

The mean value of the sides is therefore from north to south 230·374 metres, and from east to west 230·354 metres; and as the length of a side of the pyramid was 440 royal cubits, the length of the cubit derived from these measurements is 0·5236 metre and 0·5235 metre. This indicates great care in the use of the cubit measures which they had at that period.

The orientation of the axis of the pyramid may be derived from the azimuths of the sides, which were found to be:

		Mean.
North side	89° 57′ 32″	89° 57′ 48″
South side	89° 58′ 03″	
East side	359° 54′ 30″	359° 56′ 00″
West side	359° 57′ 30″	

Taking the general mean as representing the azimuth of the axis, it is only 3′ 06″ to the west of true north; and this result was doubtless obtained with the aid of the "merkhet" or plumb-line used in connection with circumpolar stars.

This instrument was in use in Egypt from very early times, and consisted of a short plumb-line and plummet hanging from a holder (*ὡρολόγιον*), and this was aligned on any object by looking through a cleft piece of the centre-rib of a palm leaf (*φοίνιξ ἀστρολογίας*) as a sight vane. It was used for setting out a line in any selected direction with the aid of terrestrial marks or a celestial body such as the sun or a

* 'Determination of the Size and Orientation of the Great Pyramid of Giza,' by J. H. Cole. Survey of Egypt, Paper No 39. Cairo, 1925.

star. It is often referred to as being employed in the ceremony of the "Stretching of the Measuring Cord" or the laying out of the axis line of a temple at its foundation. This procedure is referred to in the inscription on the Palermo Stone which has already been mentioned, and doubtless it was a survival from very early times when the primitive shrines were actually set out on a bearing so determined.

Subdivisions of right angles do not seem to have been in use, and there is no satisfactory evidence that the rule of Pythagoras for laying out a right angle was in use before Greek times. The peasantry in Upper Egypt now employ a simple and primitive method for laying out a line perpendicular to another which may preserve an ancient practice: the ends of a rope are attached to two pickets placed at equal distances on either side of the point from which the line is to be laid out, and the centre point of the cord when stretched out gives a point on the line required.

Not only were the Egyptians of these early times competent to measure lands and lay out large buildings, but they had attained a very satisfactory accuracy in levelling, and of this the Great Pyramid at Giza furnishes proof. The rock pavement on which the pyramid was built was carefully levelled before the construction of the pyramid was begun, and levelling which has recently been carried out by the Survey of Egypt * shows that it was very successfully done. The pavement surface was found to have a slope of only 6 mm. from east to west, and of 14 mm. from south to north over a distance of 230 metres in each case, or 1 in 38,000 and 1 in 16,500 approximately. Sir William Flinders Petrie, F.R.S., in his work at the pyramid of Meidum, south of Cairo, found levelling lines marked out at cubit intervals on wing walls built at the angles of a construction in order to provide the masons with a control for their work; so that it was evidently the regular practice.

Dr. L. Borchardt, in his paper on "Nilmesser und Nilstandsmarken," adduces many facts in support of the view that the surveyors of ancient Egypt carried out a line of levelling from the head of the Delta to the First Cataract in connection with the nilometers which were built at every important town; and this too was done with a very fair accuracy, since the average slope deduced from the scales on these nilometers works out at 1 in 14,440 as compared with 1 in 13,700, as given by the levels of the Irrigation Service. The instrument used may well have been the right-angled isosceles triangle of wood, with a plumb-line attached to the apex such as the masons used; it would have been placed on a long wooden straight-edge, which in its turn rested on pickets. In this way, levelling of a very fair accuracy could be rapidly executed.

Thus we see that land-surveying was regularly practised at all periods in Ancient Egypt, although the instruments in use were of the simplest kind, namely, the measuring cord of 100 cubits (52·5 metres) and the

* 'Determination of the Size and Orientation of the Great Pyramid of Giza,' by J. H. Cole. Survey of Egypt, Paper No. 39. Cairo, 1925.

measuring rod, together with the " merkhet " for laying out lines in any desired direction.

In the valley of the Euphrates also land measurement was carried on from earliest times, though descriptions of procedure and of the instruments used are few. A tablet from Tello, which is now in the Museum at Constantinople, bears a dimensioned plan of a royal property of which the area was 208 hectares, or about 515 acres. The fields were measured with a cord just as in Egypt, and the land-measurer is referred to in the land charters known as " Boundary Stores " as the " dragger of the rope." Such a measuring line or rope, as well as a measuring rod, which was also in use, is shown in a picture of the moon-god.*

It was not until Græco-Roman times that we meet with another surveying instrument—the groma. It was widely employed in Italy, where the Romans attributed the first use of it to the Etruscans, but it was also in use in Egypt, and it seems possible that Egypt may after all have been its place of origin. Though more than one form of it is known, the groma consists essentially of two pairs of plumb-lines suspended from the ends of two rods which were set at right angles to one another. Such a pair of plumb-lines with the wooden rod which carries them at its extremities is in fact a double " merkhet," and it is not impossible that this development was due to some Greek engineer who, being familiar with the use of the merkhet in Egypt, realized the advantages of an instrument with which alignments could be laid out and lines set out at right angles to one another.

The instrument is represented on the tombstone of a certain Æbutius Faustus Mensor, which was found at Ivrea near Turin,† and on it the central pillar and the crossed arms from which the plumb-lines were suspended are shown. The metal portions of another were found in Bavaria, but the form there seems to have been different.† In this case the central pillar supported a square wooden frame, and the plumb-lines hung from the centre points of the four sides. Frontinus describes one in which a movable plate is pivoted on a stand, and the plumb-lines are suspended from the ends of two diameters taken at right angles to each other.

In 1912 Dr. M. Della Corte ‡ found in one of the houses of the Via Abbondanza at Pompeii the metal parts of a groma which were sufficiently well preserved for him to reproduce the design of original instrument as used by the gromatici of that period, 79 A.D. A full-sized example based on Dr. Della Corte's plan is now in the Science Museum at South Kensington.

The instrument consists of three parts: (1) the iron shoe or point which was driven into the ground (ferramentum); (2) the column and

* *Antiquaries' Journal*, vol. 5, pl. xlviii.
† *Jahrb. d. Deutsch. Archæol. Inst.* 1901.
‡ *Monumenti Antichi Academia dei Lincei Rome*, vol. 28.

the projecting arm (rostrum), which enabled the surveyor to bring the centre of the cross vertically above the centre of the boundary-stone beside which the groma had been placed; (3) the cross (stella) formed of two rods fixed at right angles to each other, and from the extremities of which plumb-lines were suspended. When one pair of these was aligned along a line or boundary which had been previously determined, other lines at right angles to it could then be laid out by means of the other pair of plumb-lines. With this instrument the Roman surveyors laid out the plans of their cities and camps, as well as the main roads of the country. It was with it that the agricultural holdings were delimited, since these were all parallel to the roads and paths which divided them, starting with the Cardo maximus which ran from north to south, and the Decumanus Maximus which ran from east to west.

The use of the groma for laying out agricultural holdings is referred to by Hyginus (first century A.D.), who describes the normal arrangement of field plots along the roads and pathways in cultivated land, their shape being always rectangular, and their sides parallel to the roads, which were arranged so as to intersect at right angles.*

Recently a roughly made instrument of this type, which was to be held in the hand instead of being mounted on a stand, has come to light. It consists of two pieces of palm-leaf rib 352 mm. and 342 mm. long respectively, which are tied together at right angles with a piece of palm fibre cord. The upper rod has a part of the rounded "keel" of the palm rib cut away so as to form a stop against which the lower rod rests when it is in the correct position. The plumb-lines and plummets were missing, but the upper part of each rod is deeply notched at 12 to 15 mm. from its ends for the attachment of the plumb-lines. The instrument was evidently made by some landowner or cultivator for his own needs. The precise locality in which it was found is not known, but it was with a quantity of material which was brought back by Dr. Grenfell and Dr. Hunt of the Egypt Exploration Society who went to the Fayum to collect papyri of Græco-Roman age in 1899. No mention of the groma has been found in any of the Græco-Roman papyri, but it is now certain that the instrument was in use in Egypt in those times.

In this work the Roman surveyor used also the 10-foot rod, the *decempeda*, or *pertica*, for measuring the various lengths and distances as required. Recently at Enns, in Northern Austria, the ancient Lauricum, there have been found two examples of the bronze terminal piece (capitulum) of such a rod.† Each end-piece is 8·5 cm. long, is slightly tapered, and ends in a flat circular disc which was brought into contact with the disc on the next rod when a distance was being measured. These end-pieces also bear the marks of the subdivisions of the unit of length which

* Cf. Oxé, *Bonner Jahrbuch*, vol. **128**, pp. 20 ff.

† Dr. E. Nowotny, "Römische Forschung in Oesterreich, 1912–1924," Archäol. Institute, Vienna, 1925.

was used, and it proves to be the "pes Drusianus" of 333 mm. or 335 mm., inches of this foot being engraved on the capitulum. There are also subdivisions of another unit, semunciæ (12·45 mm.) of the "pes monetalis." Another example of an end piece of a smaller type was also found at Enns on which inches of the "pes Drusianus" and digiti of the "pes monetalis" were engraved.

So far all surveying instruments have been of the simplest character, but by Hero of Alexander a great advance was made. He fully appreciated the limitations of the groma and the inconvenience experienced when it was used in the field. He therefore set to work to design an improved instrument of wider application. The result was the dioptra, which he describes minutely in his work which has come down to us. Unfortunately the eleventh-century codex which is preserved in the Bibliothèque National at Paris is incomplete at some part of the description, so that a reconstruction of the instrument is not easy. Professor Herman Schöne* has published a reconstruction, but an attempt by Mr. E. Lancaster Jones of the Science Museum to prepare working drawings from which a copy of the instrument could be made has shown that there are many points which are still in doubt and which need further study. With the dioptra, not only could lines be laid out in any direction, and vertical angles measured, but levelling could be carried out.

Before the paper the PRESIDENT (Dr. D. G. HOGARTH) said: We are to listen this afternoon to Sir Henry Lyons, the Director of the Science Museum, on a very interesting subject, "Ancient Surveying Instruments." There are few who could deal with it as Sir Henry Lyons can. He combines more different sciences than almost anybody I know. When I first knew him he was Director of the Survey in Egypt and the only member of the Egyptian Government in a high official position who both knew and cared about Egyptology—but that may be a libel on several members of the Government, particularly on Lord Cromer himself! Sir Henry is able to deal with this science both from the point of view of archæology and Egyptology, and I think it will be most interesting to hear him.

Sir Henry Lyons then read the paper printed above, and a discussion followed.

Colonel E. M. JACK (Director-General, Ordnance Survey): I have listened with great pleasure to Sir Henry Lyons' most interesting paper. I think we must admire the accuracy of the results attained by the earlier surveyors in spite of the very primitive instruments they had. The only thing that occurs to me to say is what amounts to nothing more than a confession of ignorance. In the Library at the Ordnance Survey there is a Latin inscription put up by my predecessor to the effect that it is the Library of the Ordnance Survey of the British Islands, and in that inscription the word *gromaticus* appears. I did not know that word when I learnt Latin, and I have always wondered where it came from, but after hearing Sir Henry Lyons' paper I feel I know.

Mr. LANCASTER JONES (Science Museum): When we first commenced

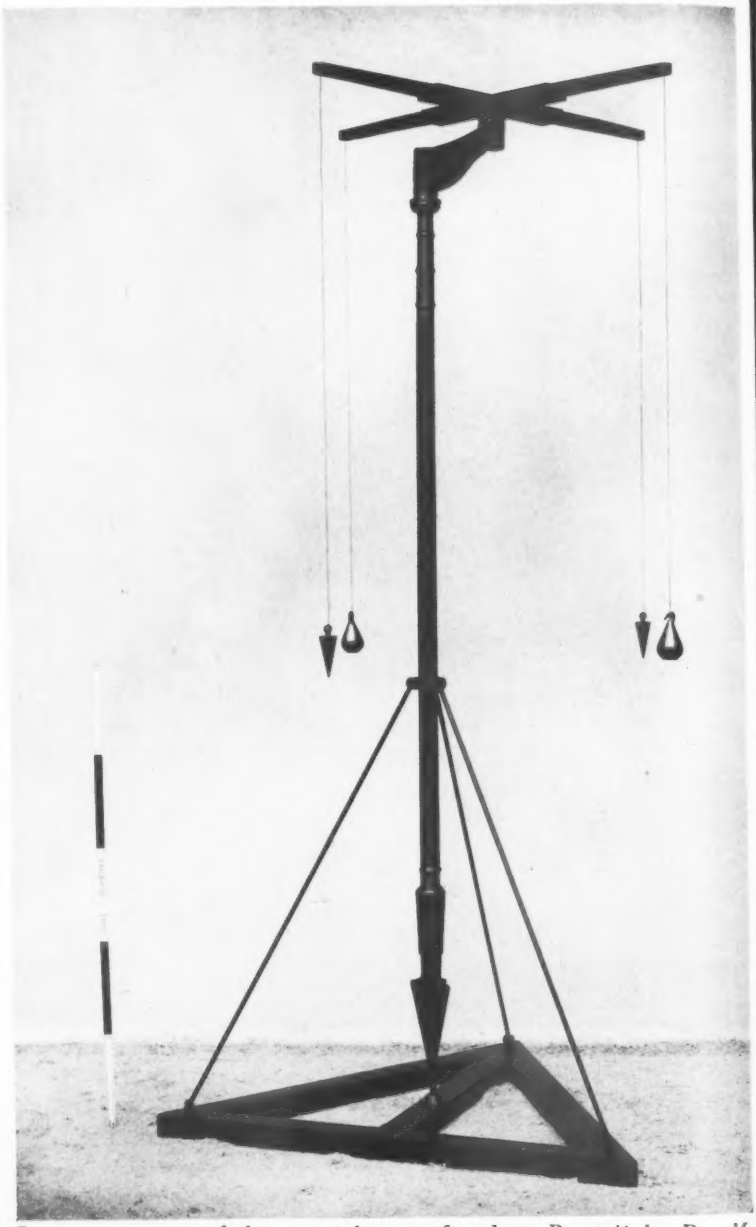
* *Jahrb. d. Deutsch. Archæol. Instituts*, 1901.

to reconstruct the dioptra we wrote to Professor Schöne hoping to get copies of the drawings he had had made about 1903. They were said to have been made by the engineer J. Neumann, and one would imagine they would have been dimensioned, and that from them it would be possible to reconstruct the instrument. Unfortunately, in his letter to us Professor Schöne said he had lost the drawings and doubted whether he could find Neumann again—I think he was dead; but he sent what he said were sketches which he had made when he was a battery commander during the war, and evidently he had been instructing his subalterns in the gentle art of surveying in olden days. Unfortunately, these are more in the nature of sketches than dimensioned drawings, and it is impossible to work from them back to the actual dimensions which Professor Schöne himself apparently thought correct. For example, the length of Hero's dioptra; the length of the levelling sight rule is given as 4 cubits, that is to say 6 feet. Now in the actual working drawings I measured up the lengths to scale, and I found the height of the instrument would be about 10 feet. That is absurd. You cannot imagine anybody using a surveying instrument and getting a ladder to climb up to sight along it. So that one could not work out the various dimensions from either the drawings in Professor Schöne's paper (*Jahrbuch d. kais. deut. archäologischen Instituts*, 14, 1899), or from the sketches. Thus I had to come to a sort of compromise and work out, roughly, as near a proportion as I could get.

Another difficulty then arose in connection with the materials of which the instrument was made; one could imagine the column of wood, whilst other parts are definitely described as metal, a metal cylinder and a metal disc; but when you start making metal plates 2 or 3 feet in size, then you get a certain amount of weight, especially in the semicircle, and it struck one that the whole thing was going to be very massive. I could not see any solution except having gangs of slaves to carry the instrument about. Sir Henry Lyons suggested that they might, as with the groma, have lined or encased it with metal whilst the actual inside was wood. That would solve the problem of mass, and we decided we would do that. But on going into smaller details we really got up against snags.

There is the question of the semicircle. On the first look one's thoughts immediately go to the altazimuth theodolite, and one is tempted to regard the dioptra as the first of such instruments, but I do not think that would be correct, for the simple reason that there is no record in Hero's text that he actually used this as an altazimuth; *i.e.* for the purpose of reducing inclined lines to the horizontal. What he, apparently, used the circle for was to enable his sights to follow a vertical plane, and therefore get a point on the same azimuth which might be lower than the point he started with. He might start sighting, and then go to the other end of the dioptra and look for a point on the same vertical plane. If he used that circle for that purpose, all I can think is that he was rather wasting his time, because in the earlier days of surveying, say about 1300 or 1400 A.D., the obvious thing was to use vertical slits. It is possible to get a good long vertical sight in that way and unnecessary to do any tilting. My own impression from a certain amount of study of surveying instruments is that the actual semicircle did not come into real use, or was not required, until the advent of the telescope; with that there was not much of a vertical field, and therefore there had to be some method of sweeping a vertical plane. At any rate, Hero did not use the dioptra as we use an altazimuth. But I fancy it might have been intended partly to act as an equatorial. It is definitely stated in his work that the instrument could be

Bronze Terminals of two Roman Ten-foot measuring rods found at Enns



Groma reconstructed from metal parts found at Pompeii by Dr. M. Della Corti

applied to astronomical purposes for measuring the angular distance between the stars, and therefore he could use it to get a polar axis and to sweep the Equator with this sight.

As regards the semicircle, again one does not know any dimensions. It is all pure hypothesis. Unfortunately, there are almost certainly several sheets missing from the codex. They are just the parts which would have dealt with the vertical semicircle. Part is well described; then there comes a rather complicated statement which nobody can follow, and then there is a blank. Hero talks about the levelling rule and describes it so closely and with such detail that one must think he must have previously described the other part. Coming to the part that he does describe accurately, the levelling rod, here again one had two little snags. There is no certainty as to how the rod was mounted.

A further rather interesting little point arises in connection with the screw on the slow-motion sighting plate. This screw is intended to elevate and depress that plate. The height of the little cylinder where the screw-head is connected to the metal plate is given by Hero as half a digit. If you take that as $\frac{3}{4}$ inch, he had to get a threaded rod with a cap on it which fits inside and is connected to the plate. A modern engineer could do that, and Neumann's reconstruction showing the method of doing it is essentially the way in which a modern engineer would do it. He splits the cylinder into two parts and makes a recess in each part to take the cap of the screw, and then he screws the cylinder on to the plate. It is very nice for a modern engineer with his B.A. threads and so on to do that sort of thing. But could they do it in Hero's time within $\frac{3}{4}$ inch?

There is also the question of the threaded rod. We have never discovered the existence of an actual threaded rod at that period. It is little points like these that rather hold one up in reconstructing. One does not want to do it in the modern fashion, of course. Though Hero gave a lot of details, they only carry one so far and then one stops. I hope that eventually we shall be able to reconstruct the instrument, because there is no doubt that in many ways it is very fine. He has a tangent screw in the general instrument, and you will notice on the top a groove which is to enable the screw to be rotated sufficiently to disengage from the cog-wheel and therefore to allow the whole instrument to be rotated quickly to within a short distance of any desired sighting. Then you re-engage again and do the slow-motion part. In other words, there is quick and slow motion. Hero describes that in great detail, and there is no doubt he was extremely proud of it—I think with great reason. You get a similar arrangement in the vertical semicircle. These are things of which we have no doubt because he describes them himself. One would be very keen to reconstruct that instrument if one could be reasonably certain of the details.

Dr. H. R. H. HALL (Keeper of Assyrian and Egyptian Antiquities, British Museum): Whilst I have had an opportunity of reading Sir Henry Lyons' paper beforehand, I have suffered from not being able to be here to hear the actual lecture, for which I must apologize. It struck me that Sir Henry had given a very interesting account of the development of Egyptian ideas on the subject of land measurement. He also touched upon the same knowledge among the Sumerians of Babylonia. Of course in both countries there was a fertile field for the growth of the science of measuring land, especially in Egypt. The whole of the cultivated land there being covered by inundation of the Nile every year made it necessary, from the beginning of royal, priestly, and private property in land in Egypt, that the soil which had arisen from the

Nile every year should be measured out, as it still is every year, anew. So that it is even more likely that land measurement grew up first in Egypt rather than in Babylonia, where conditions are not quite the same: though there was and is irrigation there, and often there are floods, there is no regular inundation. Sir Henry Lyons pointed out the great antiquity of the science or knowledge of land measurement, and he showed us that Egypt was in all probability the original home of that art and science. I am not perfectly certain, even after his descriptions, how one or two of their instruments (of which he has shown us models) exactly worked. But that is my own fault. I have no mathematical or pseudo-mathematical attainments of any kind and no mechanical knowledge; surveying instruments are not within my purview, and are beyond my scope. But there are others here who are more intelligent than I in matters of that kind, and they will no doubt be able to understand how these very primitive methods of measuring land actually worked. I hope, however, that I may be allowed to congratulate Sir Henry on his most interesting paper. In conclusion, I should like to refer appreciatively to the accuracy and beauty of the models of the *merkhet* and other examples of Egyptian measuring instruments in the Berlin Museum, which he has been able to show us. They are perfect reproductions of the originals, and reflect great credit on their makers.

Mr. HINKS: I can answer the question how the word *gromatici* got to Southampton. When Sir Charles Close was putting up those inscriptions, after rearranging and beautifying the Library of the Ordnance Survey, he wrote and asked me—I was at Cambridge—if I could get any one there to turn the inscriptions into Latin. I naturally consulted Sir John Sandys, who was unable to suggest any word in classical Latin with which he was satisfied, so used *gromatici*, from the letters of Cassiodorus, who was prime minister to the Ostrogoth King Theodoric. In the letters there is a long and interesting description of how the students in the schools of Rome were all forsaking the study of letters and art and were flocking with the surveyors in the field, for apparently surveying had become at that time a popular and profitable profession. Any one who is interested in pursuing the matter will find an interesting account of the profession of the *gromatici* in the Letters of Cassiodorus, of which I believe a good translation was published in England some twenty years ago.

The PRESIDENT: If no one else has any observations to offer I must thank Sir Henry Lyons, on your behalf, for an interesting paper, and Mr. Lancaster Jones for his interesting supplement to it. It was exceedingly valuable to hear the practical difficulties that have arisen in reconstructing the most complicated of these ancient survey instruments. I have been a digger in my time, and I have an uneasy conscience that I was really responsible for that primitive wooden instrument from the Fayum. I seem to remember it as coming from the year 1897, when, with the late Professor Grenfell and Dr. Hunt, I dug two mounds to the north of the Fayum. If so, I am bound to say we did not recognize it as a surveying instrument, and it was not the only one of that type that we found. I am sure we took it for something much more simple—something on which to wind a hank of yarn! That suggests to me this practical point. Sir Henry thought the only progress which could be made in the reconstruction of these ancient survey instruments was by a very careful examination of all ancient literature which bears in any way upon their use. I fancy that excavation will perhaps, in the end, do more. But it is necessary, if excavation is to do more, that the excavators should be aware of the existence

and nature of instruments like that in antiquity; because they will find them resolved into their parts. There is little chance of finding such an instrument complete with all parts together. The difficulty will be to recognize those parts when they are lying separately. It is very easy to mistake the nature of that sort of thing when you find it, and in a Fayum house, to neglect it and bundle it all together into some midden that you make of your less important finds. Thus knowledge may be postponed for many years, if not for ever. I wish that there had been more practical diggers here to-day; and I would suggest to Sir Henry Lyons that, if possible, he should put into the possession of the diggers some pictures of these instruments and of the conjectural restorations which have been made of them, and suggest that they should keep their eyes open for component parts which may, when put together, settle his difficulties, especially in regard to working to $\frac{3}{8}$ inch, whether it was possible in Antiquity to do that very accurate work of which Mr. Lancaster Jones spoke. That, I think, would be a practical gain from this paper, which, while it has very much interested me as an old digger and archæologist, has also convicted me in my own mind of probably a good deal of neglect which if avoided might have made the position better at this moment than it is. At any rate, I will, on your behalf, offer to Sir Henry Lyons warm thanks for a very interesting contribution and stimulating study.

ROUTE TRAVERSING IN BUSH COUNTRY

Major Basil Neven-Spence, M.D., M.R.C.P.E., R.A.M.C.

I READ with much interest Mr. C. R. Niven's description (*Geogr. Journ.*, October 1926) of the method of route traversing used by him in Nigeria during the years 1922, 1923, and 1924. I can confirm every word he says as to the practical utility of the method described, because in the years 1918 and 1919, whilst engaged in combating sleeping sickness in a part of the southern half of the Bahr-el-ghazal province, Anglo-Egyptian Sudan, which was then almost entirely devoid of roads, I used a very similar method in opening up some 800 miles of road to enable periodical inspections of the inhabitants for sleeping sickness to be carried out, and also for mapping the 369-mile road from Tembura, on the Congo–Nile divide, to Tombe, on the Nile, which was opened up at my instigation, firstly in order to prevent the northward spread of sleeping sickness, and secondly in order to improve communication with the southern part of the Bahr-el-ghazal province by giving that district a fortnightly mail *viâ* Tombe on the Nile, instead of a monthly one *viâ* Wau, on the Bahr-el-ghazal.

My traversing party consisted of an observer (myself) with prismatic compass, and three Azande, or Nyam Nyams—one who acted as wheelman, after having been taught how to read a cyclometer, one who marked with an iron-shod spear the spots where observations were made, and one who, gifted with a good carrying voice, acted as caller. The routine procedure was as follows: The starting-point having been marked by cutting a cross on the ground, the observer, wheelman, and marker

moved forward, leaving the caller on the marked spot. As soon as the cyclometer registered 0·2 of a mile the wheelman stopped the party, turned about, and hailed the caller. The latter answered with two successive cries, the first of which enabled the observer to get a rough bearing on the position of the caller, whilst the second enabled him to get an exact one. Meanwhile the marker marked the spot. If the observer were not satisfied, the hail and the two answering cries were repeated; but after a little practice this was very seldom necessary. As soon as the observer was satisfied both parties moved forward, the observer's party stopping again when the cyclometer registered another 0·2 of a mile, and the caller stopping when he reached the marked spot just vacated by the observer's party. One found in practice that it was better, whenever possible, to advance in the order described and take back bearings, because it enabled one to regulate the pace of the party, and to keep an eye on the wheelman, and to branch off in any desired direction without unnecessary shouting or delay.

To the uninitiated the taking of a bearing on a sound may seem fantastic, but those who are familiar with the African bush must often have been struck by the extraordinary facility with which a native can locate and march on a call made by another native, no matter how dense the intervening bush may be. With a little practice it is easy for the white man to acquire a degree of accuracy fully equal to that of the native. I tried several other methods of sound production, such as bugle, whistle, and drum, but abandoned them all because none of them seemed to give such consistently good results as the human voice.

Once the team had been trained it was possible to move with great rapidity whenever the route happened to lie in fairly open country or along a native path or road already opened. Thus, for instance, we covered the 369 miles from Tembura to Tombe in nineteen days, taking 1844 bearings *en route*. The greater part of the road was already in existence, and we only had to cut through some 20 miles of fairly easy bush. But if the route happened to be through thick bush, the rate of progress depended entirely on the amount of clearing which had to be done with axe and billhook to enable the party to get through. During the fourteen months I was in the southern Bahr-el-ghazal province in 1918 and 1919 my practice was to spend alternate months administering the sleeping-sickness settlement, then in process of formation, and touring the district in search of cases, Dr. Nesib Baz, my loyal and capable assistant, doing the same on the alternate months. In this way during seven months I covered some 3200 miles on foot, as the result of which the route for routine sleeping-sickness inspections was finally chosen and 800 odd miles of road were opened up, surveyed, and provided with rest-houses at intervals of 7 to 10 miles. This was in addition to the surveying of the 369-mile Tombe–Tembura road, and many other hundreds of miles of cross-country routes.

Unfortunately, owing to the acute shortage of staff and great pressure of work, which kept me fully occupied during the day and often far into the night with purely sleeping-sickness work, I was unable to plot day by day the observations made during my morning and evening marches, helpful as this would have been to me. Therefore, so far as the practical value of the method was concerned I was working largely in the dark, not a little apprehensive that it might prove to be small, but buoyed up with the thought that at any rate so far as my successors were concerned almost any results would be better than none. Plotting had thus to be deferred till I found leisure to do it during subsequent leave of absence. The drawing was then done with scrupulous care on the scale of 1/50,000, using squared paper, a protractor, and a very fine-pointed pencil. The first traverse I plotted was the earliest one made, a roughly circular tour of 170 miles westwards from Tembura. The end point of this traverse on the map proved to be separated from the starting-point by a distance which represented less than $2\frac{3}{4}$ miles on the ground. This seemed too good to be anything but a fluke, but a succession of similar results soon convinced me that the method was astonishingly reliable and accurate, as it was rare indeed to get an error of as much as 3 per cent.

During a subsequent visit to Tembura in 1923 I put the method to the following practical test. It was necessary to straighten a 3-mile section of the road connecting Tembura with the sleeping-sickness settlement. The existing stretch of road was carefully surveyed by the method described and the observations plotted. Starting at the first selected point and working on the bearing obtained from the map, we cut straight through some $2\frac{1}{2}$ miles of comparatively thick bush and hit the road again within a few yards of the second selected point. Shortly afterwards I carried out an even more searching test. Owing to the increased prevalence of sleeping sickness in the vicinity of Tembura itself, it was necessary to organize arrangements for intensive inspections in this area. I therefore surveyed and mapped a 10-mile stretch of the Yubo river, together with the whole course of all the tributaries debouching into it, and fixed the position of the various headmen's houses. Then, starting from Tembura and using the bearings obtained from my map, I cut straight roads from point to point throughout the area, in every case arriving within 100 yards of the point aimed at after marching on the bearing and covering the distance indicated by the map. The two halves of the main circular road, 14 miles on the left bank and 8 miles on the right bank, ended on the map at the Yivule rest-house, the actual end points on the map being separated by a distance which represented less than $\frac{1}{4}$ mile on the ground. It was only necessary to swing each arm 1° to make the two points coincide.

It is clear that on grounds of simplicity, speed, accuracy, and applicability to bush country the method of route traversing described should

be of great value to those officials, frequently understaffed and usually ill equipped, who from choice or necessity spend their lives administering the primitive parts of Africa. Properly fixed points, even where such exist, are of little more than academic interest to the local official, who, for administrative purposes, needs reasonably accurate detail on a scale of not less than 1/250,000. I feel, therefore, that I need offer no apology for encroaching on the pages of the *Journal* with a description of a method which seems to answer the purpose fully.

[*A large file of records, plotted traverses, and route maps, which was sent by Major Neven-Spence with the above paper, is deposited in the Library.*]

THE DIAMOND FIELDS OF SOUTH-WEST AFRICA

Die Diamantenwüste Südwest-Afrikas: zugleich Erläuterungen zu einer geologischen Spezialkarte der südlichen Diamantfelder 1 : 25,000 aufgenommen von W. Beetz und E. Kaiser.— Edited by **Erich Kaiser,** with contributions by **W. Beetz, J. Böhm,** the late **R. Martin, H. Rauff, M. Storz, E. Stromer, W. Weissermel, W. Wenz,** and **K. Willmann.** 2 vols. Berlin: D. Reimer. 1926. 12½ × 9½, (vol. 1) pp. x. + 321, 13 *maps and* 4 *plates;* (vol. 2) pp. vii. + 533, 52 *plates and* 32 *stereographic photographs. Coloured frontispiece by Axel Eriksson.*

THE economic importance of the diamond fields of South-West Africa has led to their detailed study and the preparation by E. Kaiser and W. Beetz of a six-sheet map of the Namib or coastal district. This map includes about 40 miles of the coast north of the Orange River, extending about 8 miles inland, and it is accompanied by others on a larger scale of special areas, and by some illustrating particular problems. The character of the country depends on the interaction of geographical and geological factors, and both aspects are well represented on the maps. Dr. Kaiser began his field work in 1914 and remained in South-West Africa until 1919. The results of the observations of himself and his colleague, W. Beetz, and the reports by eight other authors on their collections, are now issued in two large and magnificently illustrated volumes. The publication of the results of the survey in one work has the drawback that the two volumes are ponderous to handle, and as the maps were printed between 1922 and 1925, and the printing of the text began in 1924, there are some serious differences between the maps and the present interpretation of the evidence. Thus some marine beds are assigned on the maps to the Miocene, but have been proved by Böhm to be Eocene—a difference important in its bearing on other parts of Africa. The collected issue of the results is convenient for reference, and the monograph constitutes a most valuable contribution to African geography and geology.

This part of South-West Africa consists in the main of a folded belt, in which the axes are in general parallel to the coast. This belt lies against the unfolded plateau, and has been traversed by three rift valleys, which trend at a high angle with the coast. The foundation of the country consists of primæval schists and gneisses, which are intruded by ancient granites and covered in places by two sets of unfossiliferous stratified rocks, each containing much dolomite; the lower, the Konkip Formation, contains some schistose dolomite, and is regarded as pre-Palæozoic: the upper is described as the Nama System,

and is correlated doubtfully with the Cambrian, though its pre-Cambrian age would appear on the whole more probable. Then follows a long unrecorded interval: the next rocks are the Jurassic dolerites of the Karroo—which are described by Willmann—and then an interesting volcanic series consisting of lavas rich in alkali, such as the phonolites of the Klinghardt Mountains, and melilite basalts. Dr. Kaiser gives the name Klinghardtite to a variety of phonolite in which the nepheline has been greatly altered; this rock and the coarse-grained porphyritic phonolite with which it is associated, are similar to the Kapitian phonolite, the oldest lava in the great volcanic period of Kenya Colony. The age of the volcanic eruptions of South-West Africa is determined as either Upper Cretaceous or Eocene, which is the date assigned to the Kapitian series in Eastern Equatorial Africa. This age is proved for the Klinghardt volcanoes, as they are later than the Lower Cretaceous, and pebbles of the phonolite occur in the Middle Eocene gravels. The evidence for age is less definite in Kenya Colony, and the establishment of the date of the melilite basalts and phonolites of South-West Africa is a valuable contribution to the volcanic history of Africa. The age of the lavas is fixed by the marine beds of the Bogenfels diamond field: a series of fossils including Bryozoa, molluscs with the nautilus Aturia, fossil sharks and other fish, which are described by Böhm, are Middle and Upper Eocene. A remarkable coral is interpreted as a survivor of the Stromatoporoids, a group long regarded as having become extinct in the Devonian.

In a report on the land and freshwater fossils Dr. Stromer discusses their bearing on the geographical relations of Southern Africa, and shows that the mammals give no evidence of any land connection with South America in or after the Miocene. He also holds that there is no confirmation of Tullberg's view that in the early Kainozoic South-West Africa was separated by an arm of the sea from East Africa, which was then joined to Madagascar.

The coastal terraces include an old series of which there is no proof of a marine nature; later raised beaches occur at the heights of 40 metres, and still younger beaches at from 5 to 10 metres above sea-level.

After the retreat of the Eocene sea the country became a desert, and the development of desert topography is discussed in detail in an interesting chapter by Kaiser on the factors of desert formation. He attributes the influence of the wind mainly to deflation (the distribution and heaping up of sand and dust by the wind) and to corrasion (a term which he uses for the scouring, grooving, hollowing action of wind-borne sand). Herr Storz describes the cherts produced under the same conditions by silicification and by deposition in water, and Rauff the fossils in the pre-Eocene cherts.

South-West Africa seems to have been a country always liable to desert conditions. The ancient Nama sandstones have abundant ripple-marks like those of dunes. The Upper Cretaceous and Lower Eocene land showed a transition from a moderately to an extremely arid climate. The advance of the Middle and Upper Eocene sea produced moister conditions; but the Miocene was marked by semi-arid conditions and was followed by a relapse to extreme aridity. There appears no evidence of a still increasing drying up of the country in historic times, such as has often been asserted. The last movement described has been a slight fresh advance of the sea with a somewhat moister climate. The severest desiccation was pre-human.

The Bushmen, the aborigines of this district, are discussed in a memoir by the late R. Martin, who quotes the rival views regarding the purity of that race; he concludes that no race is quite pure, that the Bushmen are so

essentially, that their nearest kin are the Hottentots, and that they have not been influenced by a Phœnician intermixture. He describes some Bushmen skulls and remains of skeletons collected during the survey.

The most important economic mineral of this part of South-West Africa is the diamond, which occurs in sands along the coast. According to a widely accepted theory the diamonds have come from basic igneous rocks now under the Atlantic, and have been washed ashore and carried north by the Benguella Current. Dr. Kaiser insists that except during part of the Eocene the sea can have played no part in the distribution of the gems. He considers that they came from the interior, where they were formed in association with various igneous rocks, and that they were subsequently included in an extensive sheet of sandstone. From this bed they have been carried into many later alluvial deposits, the richest concentration being by Eocene rivers. The diamonds are associated with native gold and copper, iron, and manganese oxides, and with zircon, garnets, epidote, sillimanite, tourmaline, topaz, monazite, quartz, felspar, etc. This association does not suggest an ultra-basic volcanic source, but formation by contact-metamorphism combined with the action of superheated acid steam. The diamond fields in many respects resemble that recently discovered by Kitson on the Gold Coast, and as there, the diamonds are small—the largest known weighing only 50 carats—but of high quality.

Many of the photographic illustrations are pasted in place and are clearer than such figures usually are when printed with the text. The work has an excellent bibliography and index. J. W. GREGORY.

SURVEY OF INDIA GENERAL REPORT, 1924–1925

IN this latest issue there is an important departure from previous practice in the form of the Survey of India annual departmental report. Leaving this change and other important changes foreshadowed for later consideration, those interested in Indian maps and surveys will first turn to the record of progress made in the main task of the Survey of India, the topographical survey of the country and the preparation of maps from it.

Table 1 of the abstract of topographical work shows the steady progress made. In 1913–14, the last year unaffected by the war, the annual out-turn had risen to about 56,000 square miles; it had fallen to under 14,000 in 1918–19, the year most affected, and since then it had gradually risen to over 61,000 in 1922–23. The reduction to 44,000 square miles in 1924–25 is clearly to be accounted for by the exceptionally high proportion of large-scale work, and perhaps also, to some extent, by the retention of the headquarters and a portion of a topographical party on drawing during the field season.

The 1-inch map of India includes some 6000 sheets. About 2000 of these will probably not be surveyed and published on the 1-inch scale, the country they cover being, at present at any rate, capable of adequate representation on a smaller scale. Over 2000 sheets have now been published, so that the work may be considered as half done, but it is to be expected that an increasing proportion of the areas allotted to 1-inch survey may be found, as the country develops, to require survey on a larger scale.

The complete $\frac{1}{2}$-inch and $\frac{1}{4}$-inch maps will cover some 1600 and 450 sheets respectively, of which 450 $\frac{1}{2}$-inch sheets and 125 $\frac{1}{4}$-inch sheets have been published.

The standard geographical map is "The Map of India and Adjacent Countries" on the 1/Million scale. Two of the sheets were published during the year under review, and the index chart in the Map Publication volume shows that the map is now available for practically the whole of India, except the provinces of Assam and Burma, of which the sheets are still in hand, and for large areas outside India to the west and north.

India is taking its part in the preparation of the International Map of the World. No Indian sheet of the map was produced during the year, but fifteen of the sheets which include portions of India were previously available, and seven more are in preparation.

None of the sheets of the general map, called "The Southern Asia Series," was published in 1924–25, but eight are in existence and eight more are in hand.

Turning to the geodetic results of the year: although work in connection with the primary triangulation, which was stopped during the war, has not yet been resumed, deflection and gravity observations were made at a number of stations, astronomical latitudes being obtained in Kashmir and in Assam and Bengal, and pendulum observations made in the Panjab and Kashmir. It is interesting to see that "the Assam and Bengal results show that the Hayford theory of uniform isostatic compensation is very imperfectly realized in this area."

A length of 1100 miles of primary levelling was done as part of the new geodetic level net.

Tidal observation and prediction were continued, and the Admiralty was supplied with predictions for seventeen ports for 1926. In the computing work, special mention is made of the computations for Dr. Hunter's investigation of the figure of the Earth.

Solar photography, which the Survey of India has carried out since 1878, has been made over, for reasons of economy, to the well-equipped observatory established at Kodaikanal.

Among items of particular interest in the general work of the year, mention must be made of the completion of the air-survey, scale 3 inches to the mile, of 1400 square miles of forest in the Irrawaddy delta, of which the photography and preparation of mosaics were done during the previous year. Air-survey was employed again, this time on the survey of inaccessible areas on the North-West Frontier, and experiments were begun in connection with the use of the method for cadastral surveys, the results of which will be awaited with interest. Cadastral surveys are becoming increasingly important throughout the world, and any method by which the great costliness could be reduced would be very welcome.

The large out-turns of some of the topographical parties are significant. Three of the parties surveyed between 7000 and 9000 square miles each, more than half of which was original survey. Nearly two-thirds was 1-inch work, and the rest ½-inch. Quantity of out-turn is in itself an inadequate criterion of the efficiency of a party, so much depending on the nature of the country surveyed, but these are remarkably good out-turns for any sort of ground.

Some important exploration was achieved by Khan Sahib Afraz Gul of the department, who was attached to Mr. and Mrs. Visser's expedition which explored the tributaries of the Hunza River and their glaciers (see *Journal*, 68, p. 458). The Khan Sahib's survey, "which emanated from the stations of the Indo-Russian triangulation of 1913, was connected to fixed points of the Survey of India, a small adjustment only being necessary." His total out-turn was nearly 2600 square miles of ½-inch exploration survey, in country some of which is described as "probably as difficult as any in the world."

By these surveys the earlier work of Sir Martin Conway (1892) and Mrs. Bullock Workman (1908) can now be coordinated. It is satisfactory to learn that the leader of the expedition expressed " his very high appreciation of the energy, courage, and skill displayed by Khan Sahib Afraz Gul."

It was laid down in the early days that the energies of the department, outside the geodetic branch, should be confined, as much as possible, to topographical survey and mapping; but much other work is now being done for civil administrations, local surveys, and the Public Works Department. There can be no doubt that the new policy has increased the general value of the Survey of India to the country. The practical difficulties are great, and the Survey is to be congratulated on the extent to which they are being overcome.

One of the most useful items of special work carried out during the year was the execution of secondary and tertiary levelling in connection with irrigation and railway projects, and the like. By itself carrying out levelling operations of this sort, it is possible for the Survey to prevent in future the confusion which inevitably occurs when different agencies, uncontrolled by one scientific authority, scatter their conflicting values over one and the same region—a confusion not unknown even in Europe.

The new division of the Northern and Southern Circles into three circles (Frontier, Southern, and Central) should, as the Report points out, increase professional control and help to ensure the due coordination of all survey work of any extent or importance.

Other advantages which it is hoped to secure are a closer touch with the Survey requirements of the army and improvement in the mobilization arrangements of survey units for war. Experienced survey officers will be stationed at the headquarters of the Northern and Western Commands, with the necessary skeleton cadre of a survey company in each. It is hoped eventually to maintain an air-survey section with each company.

Another change foreshadowed in the Report is the preparation of a new series of sheets on the scale of 2 miles to 1 inch. Work in connection with this was done by the headquarters and the nucleus of a party during the field season, a rather unusual arrangement. The additional series would appear to be somewhat of a luxury, seeing that India is preparing complete series on the $\frac{1}{2}$-inch, $\frac{1}{4}$-inch, and 1/Million scales, and that about three-quarters of the work on the two first of these has yet to be done; but the new map is intended specially for flying men and motorists, and it is possible that the demand is a strong one. As the map will include large areas not yet covered by modern survey, the task of its preparation will be no light one if the results are to be satisfactory.

The present issue of the General Report includes only brief abstracts of the out-turns of the geodetic and mapping work, and gives no indication of the progress being made generally in Indian geodesy and mapping; it concentrates on the work of the ordinary field parties and detachments. Information regarding geodetic and cartographic work is now given in two special volumes, the old General Report being thus replaced by three volumes, ' The General Report, ' The Geodetic Report,' and ' The Map Publication Report.'

Judging from the first and third of these volumes (the Geodetic Report is apparently not yet available), the new reports have been carefully prepared and many minor improvements have been made. Soon after the reorganization of the department, which followed the India Survey Committee of 1905, the old system of one fairly comprehensive and technical General Report for the department was found unwieldy, and the detailed descriptions of the year's

working were relegated to a separate volume, known as the Record Volume. The present change is a further move in the same direction, the general abstract being cleared of still more of the technical information. At the same time it has been cleared of some general information and is mainly concerned with field work.

There is perhaps some advantage to the Government and the public in the exclusion from the General Report of a certain amount of technical detail: for instance, there is the substitution of a single comprehensive index map showing the progress in survey and topographical mapping, for the old complete series of seven index maps now included in the Map Publication volume. On the other hand, there will be some inconvenience in having to refer to three volumes. The mapping and publication of the field work is really a part of topographical operations, and the gradual completion of the smaller-scale geographical maps is also an important part of the main task of the department. It would probably make future General Reports more useful if some brief indication of the progress made in these directions and in geodesy were included in them, leaving all technical detail to the special volumes. Such details as those regarding the printing of the minor publications might perhaps be relegated to the Map Publication Report.

Under the system inaugurated by the report for 1924–25 the period dealt with by the Map Publication Report is the same as that dealt with by the General Report. The survey year in India begins on October 1, about which date the parties take the field. The "publication" year, however, now begins on April 1, in order to conform to the financial year, so that the area reported in it as drawn by a party will no longer be the area that is reported in the General Report of the same date as surveyed by the party. This is perhaps not a very important matter, but it may possibly confuse those outside the department who consult the reports.

A sketch of the services of Khan Bahadur Sher Jang, one of the most distinguished Indian officers of the department, who retired in 1925, is added as an appendix to the General Report, and its frontispiece is a well-executed photogravure portrait of the same officer. The long list of war and political services and explorations, the references to their dangers and hardships and to their valuable results, make, with the graceful appreciation of the Khan Bahadur's private character, a record of which the brotherhood of surveyors may be proud.

W. M. C.

THE UNSTABLE EARTH

Our Mobile Earth.— Professor R. A. Daly. New York: Charles Scribner's Sons. 1926. Pp. xxiv. + 342. 188 *Maps, Diagrams, and Photographs.* 21*s. net.*

Regions of Compression: Presidential Address to the Geological Society of London.— Dr. J. W. Evans. F.R.S. *Q.J.G.S.*, vol. **82**, 1926, pp. lx.–cii.

THIS fascinating and beautifully illustrated book, which attempts to sketch the main processes by which the Earth has attained its present shape, structure, and surface features, contains the substance of a series of popular addresses given during January 1925, at the Lowell Institute of Boston. Professor Daly is well known throughout the geological world as a brilliant exponent of the method of multiple working-hypotheses, for the

creation of which he has an unrivalled facility. At a recent dinner of the Geological Society of America the younger spirits of that assembly welcomed their Harvard colleague with a song appropriately beginning:

> " Every morning in the year
> Daly has a new idea ! "

In this boldly planned book we are given the harvest of his recent speculations. Fortunately the book is much more than that, for while scientific guessing may be out of date by the time it is published, the evidence remains. Daly is an indefatigable collector of data, and his method of presentation of the facts is as complete and as attractive as his industry and easy picturesque style can achieve.

The book fittingly begins with two chapters on earthquakes, which constitute by far the best popular review of that difficult subject that has yet appeared. Prof. Daly quickens the imagination whether he is dealing with destruction of life or remedial measures, the measurements of earthquakes or the messages they bring from the hidden depths. He restores a sense of proportion by pointing out that the death rate by earthquakes is only " one-sixth of the rate at which the automobile is destroying lives in the United States alone," and while he keeps the human drama in the foreground he skilfully works in the leading results of modern seismology, and the records of seismographs cease to be dryly technical.

The third chapter deals with the interior of the Earth, and here, unfortunately for some of the later speculations, the evidence which has become available since the book was prepared leads to very different conclusions from those advocated by the author. It is suggested that the continents consist essentially of a layer of granite averaging 34 miles in thickness, lying on a few miles of " crystallized basalt," which in turn is underlain by less dense " glassy basalt." Beneath the oceans granite is absent, but the crystalline basalt goes down more deeply than the corresponding layer beneath the continents, and finally merges into the universal substratum of plastic glass. There need be no hesitation in rejecting this conception as unsound. In 1924 Gutenberg interpreted the data for seismic waves of the long or surface type which had passed through the foundations of Eurasia to indicate 30 km. as the average thickness of that great continental area. Stoneley however pointed out that dispersion effects had not been taken into consideration, and Jeffreys then found that a more rigorous discussion led to an estimate of 15 km. for the thickness of the *sial*. Still more recently Jeffreys has found that compressional waves are transmitted through a superficial layer of 10–15 km. in thickness with a velocity of 5·6 km./sec. This agrees exactly with the velocity in granite as calculated from the density and compressibility of granite at corresponding pressures. Next there is an intermediate layer of about the same thickness in which the velocity is 6·2 km./sec. This satisfies the data for either basaltic glass or diorite. Of these alternatives diorite is by far the more probable (see *Nature*, 23 October 1926, p. 586). Still deeper the velocity rises to 7·8 km./sec. The available work on the compressibility of rocks at high pressures—carried out by L. H. Adams and his colleagues at the Carnegie Institution of Washington—suggests dunite (a peridotite composed essentially of olivine) as a possible material at these depths. But since basaltic material almost certainly underlies the continents as well as the oceans, it is likely that the *sima* is composed of eclogite (a high-pressure and dense facies of basaltic material) passing down at some depth still unknown into peridotite. But quite apart from this alternative interpretation the seismic data are clearly fatal to Daly's conception of a granite

layer 34 miles thick and a substratum of glassy basalt extending downwards from a depth of about 40 miles.

Another argument against a thick granite layer depends on the radioactivity of the rocks and the consequent generation of heat within them. All the internal heat lost from the surface of the continents can be fully accounted for by a layer of granite and diorite only 20 km., or 12 miles, in thickness. As the material from greater depths—represented by the plateau-basalts of every continent—is also radioactive, it seems certain that even with a limited thickness of *sial* the heat generated below must accumulate and lead to fusion. This is an aspect of the mobile Earth that Daly fails to develop. He ignores the implications of radioactivity except for the statement that " radioactivity means the steady evolution of heat." Had he followed up the logical consequences of the heat developed within his substratum of glassy basalt he would have reached conclusions even more catastrophic than those of Professor Joly.

On the premises adopted Prof. Daly has no need to meet the great difficulty which formerly stood in the way of explaining vulcanism, namely the necessity for supplying latent heat to provide magmas. His basalt is already a hot glass which on relief of pressure, as for example at the base of a tension cleft, becomes mobile and works its way upwards, aided later on by the effervescence of escaping gases. In order to provide conditions whereby both fissuring and mountain building can be simultaneously produced, the deformation of the Earth by distortion on a planetary scale is next considered. The three co-operating causes to which appeal is made are contraction by cooling ; retardation of the rate of rotation ; and denudation of the lands. As a result of these or other processes the surface has been furrowed into huge gently sloping domes and basins, and it is suggested that the crustal layer of granite, thus thrown out of level, broke up into fragments comparable with the existing continents. Moreover, the fragments, no longer securely anchored, became gigantic landslides and migrated down the slopes of the domes, crumpling the weaker belts in front of them into mountains, and leaving behind them the open spaces of the oceans. In this way Daly attempts to provide a force capable of overcoming the resistance to continental migration. He believes all the older theories of mountain building to be inadequate, and finds a solution of the mystery in the revolutionary conceptions developed independently by Taylor and Wegener. But he rightly warns the reader that " speculation is not science or knowledge." The really valuable part of the discussion is the vigorous description of the surface structure of the Earth as a whole and the able summary of the obdurate riddles that have to be faced.

The final chapter deals with the origin of the Earth—preference being given to the views of Jeans and Jeffreys—of the continents and of the moon. The existence of continents is recognized, for the first time in a popular book, as one of the principal mysteries of nature. A further special difficulty is to explain their asymmetry. This peculiarity of distribution has generally been ascribed vaguely to the catastrophic birth of the moon from the Earth's flank. According to Jeffreys, however, the separation of the moon could only occur when the viscosity was such that the outer zones of the Earth would speedily become once more symmetrical. Daly tries to avoid this difficulty by suggesting a primary hemispherical asymmetry deep within the interior which persisted even after the tearing off of the moon. Here we are literally out of our depths and must be content to await further evidence. The Earth keeps its own archives of its fantastic adventures, and there is no need to despair because some of them are still hidden or remain indecipherable.

It is only fair to point out that Professor Daly is far from being dogmatic. His guesses and speculations are clearly recognizable as such, and whether one is in sympathy with them or not they serve as a condiment to the solid meat of a very satisfying intellectual meal. "The poetry of Earth is never dead," and in this stimulating book our author has rejuvenated a sense of romance and mystery which will be felt by all its readers.

Complementary to his Address on "Regions of Tension" (reviewed in the *Journal* for March 1926) Dr. J. W. Evans has now expounded his views on the phenomena and structures that indicate the existence of compression in the Earth's crust. His treatment of the subject is packed with suggestive ideas; but the problems are baffling, even the evidence tself is almost incredible, and opinions as to interpretation are as diverse as the number of the authors who have discussed them. It is therefore no matter for surprise that the Address under review is particularly provocative of criticism. It was hoped that Dr. Evans would consider the effects due to the release of energy involved in the atomic decay of uranium and thorium. Clearly however he is not prepared to go far in this direction, for at the outset he suggests that a considerable proportion of the energy liberated by the radioactive elements in rocks is not converted into heat, but is used up in effecting endothermic changes in the surrounding minerals. When the heat developed by radium is experimentally determined the glass container becomes intensely coloured by the rays, just as minerals do in natural circumstances. If Dr. Evans' suggestion were valid we should expect that the heat so determined would be considerably less than the heat-equivalent calculated from the number and energies of the rays themselves. But the two are equal within the limits of experimental error, and the expenditure of energy by other processes than conversion into heat must therefore be much less than 1 per cent. of the total. We can only conclude with Lord Rayleigh and R. W. Lawson, that the evidence is definitely against Dr. Evans' proposal for thus disposing of radioactivity.

To decide whether the contraction due to cooling is sufficient to account for the observed folding and overthrusting of the rocks Dr. Evans appeals to the work of Dr. H. Jeffreys, who has shown that in an earth that has been continually cooling for 1600 million years the area of the surface will have decreased by over 4 million sq. km. The principal mountain ranges of the present day indicate a decrease estimated by Jeffreys at about half this area. Dr. Evans points out, as other authors have done, that most of the older folded regions are no longer mountainous. Such are the Hercynian, Caledonian, and pre-Cambrian foldings representing the sites of ancient ranges now worn down by long-continued denudation. But while Dr. Evans justly considers the observed compression to be far greater than the calculated amount, he also shows that there is reason to believe that the latter has also been underestimated. The contractions involved in crystallization from amorphous magma; in loss of volatile constituents; in change of facies producing minerals of lowered molecular volume; and in the slowing down of the Earth's rotation have not been allowed for in the cooling theory. Moreover, the Earth's outer shell may be increased in area by normal faulting; by the filling of fissures by dykes; and by hydration (as, for example, in the conversion of peridotite to serpentine). All of these processes add to the possible amount of crumpling.

The change of form due to reduction in the rate of rotation implies, as is well known, a decrease in the equatorial diameter. Long ago Chamberlin

deduced that this would involve the production of mountain chains lying across the equator, and since such ranges are infrequent he concluded that any considerable change in the rate of rotation was improbable. Dr. Evans, however, points out that the contraction due to this cause would lead to flowage at all depths towards the poles, distorting the Earth in such a way as to extend the continents laterally north and south—presumably by diagonal shearing. For a different reason continental areas near the poles would tend to drift towards the equator. It is also suggested, as in the first Address, that a drift towards the Pacific may have occurred, this movement being dependent on the possibility that the Earth's centre of gravity may not correspond with its centre of form.

Dr. Evans has rendered valuable service in thus revealing the extreme complexity of the interacting processes. He goes on to ask why the manifestations of contraction are concentrated in particular tracts, and confined to specific periods of time. To illustrate the problems examples are taken from the geological record of the British Isles and adjoining countries. The detailed discussion of the events that culminated in the Hercynian Earth storm, and of the later events that led to the still greater Alpine revolution, provides an admirable study of the two best-known cycles of Earth history, and will be widely appreciated by geologists of all shades of opinion.

Unfortunately, no satisfactory explanation of the origin of geosynclines yet appears to be forthcoming. Dr. Evans refers the depression of a uniform sea floor in the first place to localized accumulation of sediments, and afterwards to downfolding by gentle lateral pressure. This would imply a defect of gravity which in the writer's opinion would be far in excess of known departures from isostatic equilibrium. The analogous Gangetic Plain does in fact show a defect of gravity, but this can be alternatively explained by the concentration near the surface of sediments of low density. But geosynclines, however they came into existence, localize tracts in which the underlying crust is bent down into regions of higher temperature and thus doubly weakened. Later, "the time arrives when under the slowly increasing horizontal compression the subsided area yields and closes, so that the contained sediments are forced up in folds to form a new mountain range."

In recent months a good deal of work has been done on the average thickness of the *sial*, or lighter rocks of the continental areas. Ignoring the full thermal effects of radioactivity and assuming that the deepest folds go down to a depth of 86 km. below sea-level, Dr. Evans calculates the thickness of the *sial* of the plains to be a little over 40 km. But several independent lines of evidence suggest that this thickness cannot much exceed 20 km., and accepting this more direct estimate one can reverse Dr. Evans' problem and determine the maximum depth of folds to be about 40 km. below sea-level for mountains standing 5 km. above sea-level. The nature of the evidence was outlined above in discussing Daly's 'Our Mobile Earth.'

Notwithstanding the disagreement over radioactivity and the thickness of the continents, we are indebted to Dr. Evans for a masterly survey of a difficult subject such as has rarely appeared in English and which is well in advance of recent Continental work. Direct observations on the rocks themselves are of more value than the discordant notes of interpretation, and in this Address we have a valuable summary of years of work on the complexities of North Devon and adjoining tracts.

ARTHUR HOLMES.

GEODETIC OBSERVATIONS AND TRIANGULATION IN KASHMIR (DE FILIPPI EXPEDITION, 1913–14)

Spedizione Italiana De Filippi nell' Himàlaia, Caracoràm e Turchestàn Cinese (1913–14).— Series I. Geodesia e Geofisica. Vol. 1. Astronomia Geodetica, Geodesia e Topografia. Alberto Alessio e Giorgio Abetti. Bologna: Nicola Zanichelli. [1925.] 12 × 8½, pp. xxxv. + 415. *Map*, 51 *Plates and Charts*.

THE Introduction to the volumes of Series I., by Dr. De Filippi, gives an admirably concise account of the whole campaign from its first inception. The thorough scientific exploration of the broad zone between the Punjab and Chinese Turkestan (including, therefore, the Western Himalayas, the Upper Indus Valley, the Southern Karakoram, and part of the highest plateau in the world), which was the object of this expedition, might have remained an ambitious dream but for the energy of its authors and the whole-hearted cooperation of His Majesty the King of Italy and of the Italian Government. The scientific branches of the Army, the Navy, and the Universities contributed not only experts but most of the scientific instruments. Financial support came mainly from Italian sources, but also from many foreign scientific societies, including the Royal Geographical Society. Dr. De Filippi writes most warmly of the debt of gratitude which the expedition owes to the Government of India for interesting the Maharajah of Kashmir and his officials in the work, for permitting the close cooperation of the Indian Survey and the Observatories Departments, and for the loan of experienced officers.

The scientific exploration was necessarily divided into two groups: (1) the *instrumental group*, under Captain A. Alessio (lately hydrographer of the Italian Navy), and Prof. G. Abetti, who were in charge of the geodetic, geophysical, and meteorological measurements and observations, the results of which form the subject-matter of the three volumes of Series I. (2) The *exploratory group*, under Prof. G. Dainelli, in charge of the geological, ethnographical, and geographical investigations, the results of which form the matter of the nine volumes of Series II.

The complete instrumental equipment, with the personal effects and camp equipment of the Europeans, weighed 4 tons, and required for their transport alone 60 ponies and 20 porters. The supplies of European food (over 6 tons) necessitated a corresponding additional transport quite apart from the fodder and the food for the natives required during the six months spent in the Upper Indus Valley. It was no light task to organize beforehand this mass of material so that it could be subdivided almost at will and leave individuals free to move in any direction with their proportion of instruments and supplies.

From the arrival of the party at Bombay on 22 August 1913, not a day was wasted. A thorough geological and glaciological examination of the Vale of Kashmir, and the fixing of several geodetic stations between the Zoji-La and Skardo, occupied most of September. The next seven months were spent in strenuous winter work in the Upper Indus.

Meanwhile over 50 tons of food for the caravans and fodder for the horses and yaks had been collected, partly from Kashmir, partly from the Punjab, in the vicinity of Leh, and the whole expedition assembled without a hitch early in June 1914, a few miles south of the Karakoram Pass, on the Depsang Plains (17,590 feet), which had been selected as the headquarters of the expedition during its three months' sojourn in Eastern Kashmir.

Part I. Geodetic Astronomy, pp. 5–230.

Chapter I., by Prof. G. Abetti, gives in detail the various observations by Captain Alessio and himself and the methods adopted in determining eleven principal latitudes. The probable errors varied between $\pm 0''{\cdot}16$ and $\pm 0''{\cdot}34$, a degree of accuracy which might be expected in major geodetic operations, but unprecedented in the course of an exploring expedition in remote regions and under most unfavourable physical conditions.

Chapter II. is concerned with time determinations, also by Prof. Abetti. Here, as elsewhere, can be seen that remarkable attention to detail which distinguishes the methods of these two observers. The observations were undertaken partly for the determination of the difference in longitude between the various stations of the expedition and Dehra Dun, and partly for finding the rates of the chronometers and especially the rates of the instrument used for timing the pendulums in the gravity observations, the results of which have not yet been published and are awaited with great interest.

Chapter III. Astronomical Determinations of Longitude.—Prof. Abetti opens with a brief historical sketch of experiments in the use of wireless time signals prior to 1913, when radiotelegraphy was still in its infancy. In succeeding paragraphs he describes the apparatus and the methods used in the Italian expedition. At that time there was no great wireless station in India from which controlled time signals could be sent out regularly, but it was arranged that the small wireless station at Lahore should send signals (Plate XVIII.) to be received at Dehra Dun, and in the field. There is a detailed account of the conditions which favoured or prevented the reception of the signals at the various stations, and full particulars of the determination of the exact longitude of the transit instrument at Dehra Dun and of five stations in Kashmir, viz. Skardo, Lamaiuru, Leh, Depsang (connected with India by triangulation), and of three stations in Chinese Turkestan, viz. Sughet Karol (hitherto unfixed), Yarkand, Kashgar.

Chapter IV. Nautical Methods applied to Land Operations.—Captain Alessio discusses in considerable detail the value of the methods employed in the Italian Navy, in view of their comparative simplicity. He puts forward arguments for the exclusion of a Prismatic Astrolabe and for preferring the Zenith telescope and Transit Instrument for accurate determinations, and the use of the sextant for minor stations where portability was of first importance. The rest of the chapter contains minute details of the preliminary tests on the chronometers, and of the watch kept on the rates of each individual instrument; and further, an account of the determination of seven differential longitudes with the sextant and chronometers.

Part II. Geodesy and Topography, pp. 235–415.

Chapter I. The Determination of Station Coordinates.—Captain Alessio gives the details of the methods adopted by Prof. Abetti and himself for determining the coordinates of all the gravity and magnetic stations. In some cases, *e.g.* Skardo, the work amounted to a triangulation of the whole basin (see Plates II. and III., vol. 8, Series II.), and in this connection a valuable investigation was made (pp. 254–266) on the behaviour of *invar* wire at temperatures below 0° C. The coordinates of twelve stations are printed *in extenso* together with the coordinates and altitudes of all important points visible from the central stations. Among the plates will be found panoramic photographs of all these stations; on each are marked by arrows the exact positions of the instrumental stations and of important peaks. The care taken to secure future identification of the exact sites is characteristic of the attention to detail which is so marked a feature of every part of the work in this expedition.

Chapter II. Barometers and Hypsometers for Altitude Determinations.—Captain Alessio discusses the application of Laplace's formula for deducing the difference of altitude between two stations, and expresses a decided preference for the modification adopted in the International Meteorological Tables of 1890, as compared with that adopted by Angot in the *Instructions Météorologiques* of 1903.

Five mercurial barometers travelled with the expedition, and a sixth was brought out later by Prof. Alessandri, who actually carried it himself during the whole journey! The most elaborate precautions were taken in the packing and transport of these instruments, yet only the sixth actually returned safe to Italy. Two Fuess hypsometers, specially made and rigorously tested, were also included in the equipment, in the first instance merely for the purpose of studying their behaviour under extreme conditions. A most exhaustive series of comparisons between the barometric and the hypsometric results (pp. 362–372), however, greatly impressed Captain Alessio and caused him to set a high value on the hypsometer, especially in view of its portability and the small risk of damage. He therefore formulates certain important conclusions: (1) that the accidental error in reading a hypsometer is negligible as compared with the accidental errors in reading a barometer for determination of atmospheric pressure; (2) that the correction to a hypsometer is a function of the prevailing low pressure and of the prevailing temperature, and tends to increase *positively* with the diminution of the prevailing pressure and with the increase of the prevailing temperature; (3) that when, and only when, it becomes possible to ascertain the exact effect on the thermometers of these factors (long-continued low pressure and great variations of temperature), then a determination of atmospheric pressure by a fully standardized hypsometer will be of the same order of accuracy as that by a mercurial barometer of the best type, observed under the most favourable conditions.

At the end of the discussion (p. 373), Captain Alessio suggests that some mountain observatory, such as that on Monte Rosa, might usefully undertake the study of hypsometer readings under varying conditions, and he expresses his opinion that this might probably lead to "the triumph of the hypsometer over the barometer"! The attention to detail in the above comparison and in the investigation of the effect of the other variables (temperature and humidity) on the determination of altitude makes the whole inquiry a notable example of physical research, often under almost Arctic conditions.

Chapter III. Geodetic and Topographical Operations.—Signor G. A. Spranger here gives an account of the triangulation carried out by Major H. Wood, R.E., and himself, with the assistance of Jamna Pershad and Shib Lal, two experienced Indian surveyors lent by the Survey Department of India.

Heavy snowstorms in the pass behind Leh and the gorge-like valley o the upper Shyok greatly hampered the plane-table traverse and the recognition of fixed points; and, after arrival on the Depsang Plain, the weather was so bad that it was decided to measure a base and to start an independent triangulation resting on astronomically observed latitudes and azimuths. Fortunately the weather improved shortly afterwards, and it became possible to observe a great many peaks, including K_2 and one of the Teram Kangri peaks and others fixed by the Indian Triangulation. Plate XLIX. shows the chart of the Depsang triangulation: it is the framework for the fine map given in the 'Storia' of the De Filippi Expedition. As will be seen, the triangulation is divided into two parts by a west and east line through the Karakoram Pass,

and that therefore the connection between the two parts is rather weak. This weakness, however, was greatly diminished when it became possible to check the whole work by fixing the ultimate station towards the north by means of rays to the Gasherbrum peaks and to 12/52 E. The very unfavourable weather rendered the work extremely difficult, and the fine results achieved reflect great credit on all concerned.

Chapter IV. Photographic Work.—Major C. Antilli, of the Italian Engineers, the official photographer, gives a concise account of the outfit (p. 409). Films and film-packs were used throughout and proved eminently satisfactory, though special precautions were needed during very dry weather owing to the risk of electrification, and also whenever the moon was shining on snow surfaces. Pure water for developing and washing was often a very real difficulty. In addition to a large number of photographs taken by private cameras, 4000 official exposures were made and some 2600 negatives were catalogued, besides several hundred metres of cinematograph films of characteristic scenes and costumes in Baltistan and of the religious masked dances in Ladakh. The splendid plates which adorn this and the other volumes * so far published are in themselves sufficient testimony to the excellence of the photographic work. B. B. D.

REVIEWS

EUROPE

Majorca.— **Henry C. Shelley.** London: Methuen & Co. 1926. 9 × 5½, pp. xxiii. + 283. *One Map.* 10*s.* 6*d. net.*

A PLEASANTLY written book which should be in the hands of every intelligent British and American visitor to this delightful island. The first quarter of the volume gives a good account of the history from the earliest times up to the Catalan revolt of 1640 and the war of the Spanish Succession. Full use has been made of Foster's translation of the original Chronicle of James of Aragon, surnamed the Conqueror, who drove out the Moors in 1229, as well as of the standard works of Piferrer and Quadrado, Maria Bover, and other historians. Then follows an excellent chapter on Palma, the author dwelling lovingly and judiciously on the architectural details and other beauties of that charming old capital, once the pride and glory of merchant princes of the Mediterranean. The mediæval Almudaina, which incorporates much of the earlier palace of the Moorish kings, the magnificent cathedral founded by the first Christian king, and the famous fifteenth-century Lonja, or Exchange, are all well described. Readers of the book will cordially endorse the author's regret that so little use is now made of the third of these noble buildings. A few mediæval retablos and some indifferent modern paintings are practically all that is contained in this so-called "museum." And yet close by, hidden away in an almost inaccessible corner of the Bishop's Palace, "practically unknown to the visitor," is an extensive and rich storehouse of archæological treasures, Iberian, Carthaginian, Greek, Roman, Moorish, and Mediæval, crying out for such a setting as the glorious old Lonja would afford. Also, as

* The following reviews have already appeared in the *Journal*: Series II. vol. 1, 'Storia' or General Report, **66**, p. 254; vol. 3, 'Glaciology,' **63**, p. 243; vols. **8** and **9**, in **68**, p. 257. In the footnote to the last on p. 257 the following corrections should be made: line 1, for "fourteen vols." read "thirteen"; line 5, for **43** read **63**; line 6, for **46** read **66**.

the author says, " there is no more suitable place than the Lonja for a small but representative collection of specimens of the beautiful old arts and crafts of the island."

After describing various other interesting buildings in Palma and narrating exciting incidents of town life in the heyday of the city's prosperity, the author takes his readers out into the country. The well-known tourist resorts of Soller and Valldemosa (with memories of Chopin and George Sand), and the beautiful scenery of the northern mountains with the famous monastery of Lluch, come in for their due share of praise. Many of the smaller and less known towns of the central, southern, and eastern parts of the islands (Inca, Muro, Felanitz, and others) are dealt with in turn. The ancient town of Arta is briefly described, but its still more ancient prehistoric ancestor, a few hundred yards away, with its massive walls and Cyclopean gateway of three huge monoliths, appears to have escaped the author's notice.

At Alcudia there appears to have been some little confusion in the author's mind between a modern bull ring, an amphitheatre, and a Greco-Roman theatre. The last named, which, as he says, is " in a field about a mile outside the city," is no amphitheatre, although it is but fair to say that the owner and most of the natives commonly call it by that name. Nor can the reviewer assent to the startling suggestion (p. 195) that " certain cave-like apartments (which are really typical examples of the prehistoric cave dwellings so common in the Balearic isles) " must have formed part of the retiring rooms of the structure " (the theatre), which is obviously of much later date: the theatre has been built over and into the earlier dwellings.

A good chapter by Mr. Ivan Lake on the picturesque range of mountains which form the north-western boundary of the island, and then a short and sympathetic chapter on the people and their ways, bring the volume to a close. The book is well got up and profusely illustrated with excellent photographs.

The map does not bring out the great contrast between the mountains and the central, nearly flat plain. It is also not quite up to date; for instance, the railway by which the reviewer, as long ago as the winter of 1923–4, travelled from Manacor to Arta, is not shown. J. B.

Etudes sur les instruments Géodesiques et sur les résultats de la triangulation cadastrale effectuée dans l'Aisne, 1924 et 1925.— L'Ingénieur en chef Roussilhe, Directeur du Service d'Etudes pour la Réfection du Cadastre, Paris, le 10 Mai 1926.

This report, upon the results of the triangulation for the revision of the cadastral maps of the Aisne, and upon the instruments used for the purpose, is made up of ten separate roneoed pamphlets in a portfolio.

Colonel Roussilhe's name is well known to English surveyors. He commanded a French Groupe de Canevas de Tir (or Field Survey Company) in the war. He was a great believer in the rectifying camera for mapping from air photographs at that time, and since then has used this method with success in the cadastral mapping of the old war area; and lastly he was an energetic and helpful member of the international geodetic Conference at Madrid. His particular contributions on the stereographic projection and on the semigraphic method will be remembered with interest.

The cadastral triangulation which he organized for the Aisne is not what one commonly visualizes in that connection. It includes, for example, several first-order points and many of the second order. The triangular errors are about 0·8 second for the first order and some 3″ or so for both second and third orders. Linear errors are assessed at 1/70,000 for secondary and 1/30,000

for tertiary. A first-order triangulation, to swallow whole such work as this, must indeed be good.

Perhaps the most interesting fact about the triangulation is that it is computed directly in the coordinates of the stereographic projection. Computation is carried to terms of the sixth order, and it is claimed that, inclusive of residual projection error, no point is likely to be more than a decimetre out of position. The terms involved include the even powers of x and the odd powers of y, and the last term of x can mean but little unless the origin is very remote.

Field work and computation for some 2300 square miles, resulting in one point for each 10 square miles, were completed by a staff of nine in seven months.

By far the larger part of the letterpress is devoted to a description of the theodolites and azimuthal circles (theodolites without vertical arcs) made by M. Chasselon for the Service d'Etudes. These instruments were designed to give a " bearing " error of 10 centesimal seconds (about 3″). The horizontal arcs are 220 mm. (or in some cases 180 mm.), and the following are points from the specification :

Two micrometer microscopes per arc.
A movable wire in the reticule.
Silvered arcs divided to 0·20 grades.
Micrometer microscopes to allow of two revolutions per division (1 turn per decigrade).
Direct reading to the milligrade.
Telescope focal length 32 cms.
Magnification, alternatively 20 and 30.
Objective 4 cms.
Weight: (instrument complete) 13 kgs.; (box) 12½ kgs. Total, 25½ kgs.

The instruments are then of the sort to which we are accustomed, and in no way resemble the Zeiss or Wild models. They are light for their size, but not as light as one could hope for.

A very careful and interesting analysis of angular measurement by the various models, collectively and individually, is given. They seem to have stood up well to the field work and to have fulfilled expectations. Those particularly interested in instrumental design will be well advised to study the reports.

H. S. L. W.

A Dawdle in France.— Inglis Sheldon-Williams. London: A. & C. Black, Ltd. 1926. 8½ × 5½, pp. viii. + 264. *Sixteen Full-page and Fifty Smaller Illustrations from Drawings by the Author, and a Map.* 7*s.* 6*d. net.*

We have had Wanderers, Wayfarers, and Vagabonds, and now we have a Dawdler. This opens up an alarming prospect of Loafers, Loiterers, and Loungers, and it is questionable whether there is room for all these volumes, much as France has to show us. There seems to be little justification for the present work, which purports to describe a cycling and sketching tour from Dieppe to Mont Cenis, but often wanders off into idle prattle about things in general and nothing in particular. There may be readers who will appreciate the author's frantic efforts to maintain a bright and chatty (not to say slangy) style of writing; but, to be candid, " we are not amused."

A Wayfarer in Sweden.— Frederic Whyte. London: Methuen & Co. 1926. 9 × 6, pp. xvi. + 207. *Seventeen Illustrations and a Map.* 7*s.* 6*d. net.*

Although this wayfarer writes in the style and from the point of view of a journalist, his book shows considerable observation and understanding of

modern urban Sweden. Persons and instances are happily chosen, nationalist writers like Selma Lagerlöf and Carl Laurin are often and aptly quoted, and in the chapters " Swedes and English " and " Carl Larsson and his Swedish Home " there is both breadth of view and humour.

The itinerary followed is mainly along familiar routes—to Goteborg, thence by the Canal to Vadstena and Stockholm, and on to Gotland ; but the author makes excursions to Lysekil, Båstad, Helsingborg, Porjus, and Kiruna, and in his chapters on Swedish art and literature refers to many notable places. It is curious that neither Upsala nor the province of Skåne—both so historic and, in their different ways, so representative of Sweden—is described at all, and only mentioned incidentally. Lund is not even mentioned.

The author provides a background to his pictures with a thoughtful chapter on " Sweden's Three Greatest Kings "—Gustavus Vasa, Gustavus Adolphus, and Charles XII.—and two chapters on Bulstrode Whitelocke's embassy to Queen Christina in 1653-54. The space given to Whitelocke's narrative here is perhaps disproportionately great, but it is a very interesting historical document which Mr. Whyte has done well to bring to the notice of the general reader.

The author's wife, who is a Swede, has contributed a chapter on Dalecarlia, as well as passages—put, quite unnecessarily, in inverted commas—in other chapters. The photographs, some of them from pictures by Swedish artists, are good, and the book has an index. The map, which is printed on the inside of the cover, is not good enough. E. L.

Wanderdünen Pommerns.— Dr. Wilhelm Hartnack. Greifswald : Julius Abel G. m. b. H. 1925. 9½ × 6¼, pp. vi. + 112. *Twenty-three Text Figures, one Plate.*

This monograph deals with the dunes of the Hinter-Pomeranian coast. The author first gives a general account of the area—a typical flat coast whose history is intimately connected with the Baltic. The general form of the coast (*Rohbau*) owes its origin to the *Littorina* phase which affected the Baltic region.

After criticisms of earlier work the author considers the effects of erosion by various agencies on a line of dunes (*Vordüne*). The hollows (*Windmulden*) formed in this as the result of erosion lead to the development of new forms—*Haldendünen* and *Parabeldünen*. The *Haldendüne* is a crescent-shaped terminal dune formed in an erosion hollow : it is, apparently, the equivalent of the *pourrière* of the Picardy dunes (see Briquet, *Ann. de Geog.*, **32**, 1923, p. 390). The *Parabeldüne* is a further development of the *Haldendüne :* the oblique impact of the prevalent winds on this coast causes the *Windmulden* to run slantwise to the general line of dunes, in such a way that they extend to the east-north-east, or nearly parallel with the main dune belt, rather than at right angles to it.

The author's main object was to examine and explain on a genetic basis the various phases passed through by a moving dune. The Hinter-Pomeranian coast is rather unusual in its situation. In the majority of the other European dune areas (exception being made of Flanders, which, the author says, no longer possesses moving dunes) the direction of the prevalent wind is the main factor in the formation of dunes. But on the Pomeranian coast the wind approaches the coast obliquely, thus producing certain special phenomena. This is particularly noticeable if the Pomeranian dune areas are compared with the dunes on the Kurische Nehrung.

The monograph is very well produced and illustrated by some instructive photographs and diagrams. A very useful bibliography is given, containing many references to other work on coastal dunes, including that of English and French, as well as German, authors. It is a pity a general map of the area on a fairly large scale is not given. Further, a summary of conclusions would be a great help. J. A. S.

ASIA

Chinese Central Asia.— C. P. Skrine. With an Introduction by **Sir Francis Younghusband, K.C.S.I.** London: Methuen & Co. 1926. 9 × 5½, pp. xvi. + 306. *Photographs and Map.* 21*s. net.*

Among the most delectable countries of Asia is Chinese Turkistan. It is the most distant of all lands from the restless ocean, while, owing mainly to the mighty ranges by which it is encircled, no railway has reached its oases, and the camel, the horse, the mule, and the donkey remain the leisurely means of transport. Its historical interest is great, for through the length of the land ran the celebrated Silk Route, along which intercourse between China, Persia, and the Roman Empire was conducted, with a side route leading to India. Fortunately for the country, owing to the scanty rainfall and the consequent lack of grazing, the great hordes which swept westwards across Asia, devastating the country and massacring the sedentary populations, generally avoided Chinese Turkistan, which thus remained relatively unharmed and unchanged.

It is a vast country, so vast that it would take many years to travel all over it, while for the explorer, the archæologist, and the anthropologist there is still work to be done in a climate that is bracing and among a friendly people.

Mr. Skrine was appointed Consul-General in Chinese Turkistan, and, accompanied by his dauntless wife, started off from Srinagar in June 1922 on a fruitful journey of two and a quarter years. The travellers had already gained experience in the hard frontier school, having spent over a year in Sarhad, the wildest district in Persia, while Mr. Skrine had previously served as Consul in remote Kerman. His knowledge of Persian was especially valuable in a land where the most eastern group of Persian-speaking Aryans dwell, and where the civilization and art are alike deeply affected by historical Iran.

The journey to Gilgit is briefly described, but Hunza arouses enthusiasm, which results in a delightful description of its beauties on p. 25. After trying marches through the heart of the Karakoram, the boundary of the Indian Empire is reached at grim Mintaka, the " Pass of a Thousand Ibex," which rises to 15,600 feet. On its northern slope the Consul-General was welcomed by representatives of the Aryans of Sariqol, who are subjects of China, but pay tithes to their religious chief, H.H. the Aga Khan of Bombay, as also do the inhabitants of Hunza. From Tashqurghan, the chief village of Sariqol, the party gradually descended to the immense " oasis-fringed desert, which stretches for 2000 miles from Kashgar to the mountains of Inner Mongolia."

After a ceremonious reception at Kashgar, the Skrines threw themselves with enthusiasm into their respective duties. The consulate, which, thanks to the energy of Sir George Macartney, occupies the best site outside the city, is set in a terraced garden on the low cliffs which bound the valley of the Tümen Su. Its delights are vividly described on p. 56. Both the Skrines rapidly learnt Turki, and Mrs. Skrine made friends among the women and children. One visit was paid to the mother of a high official, " who might have stepped straight out of a fairy story. She looks about a hundred and fifty, wears a black silk handkerchief tied round her head like a pirate, and owns an enormous

woolly black cat, which adores her and sits all the time licking her hands and face."

There was plenty to do at Kashgar in the way of official work. At the same time it was essential to tour as much as possible, and about one-half of the Consul-General's time was spent on the road. With autumn came the touring season, which depended mainly on the fact that the rivers were easier to ford than at other seasons, while the snow had not yet blocked the passes. Even so, the country away from the plains is perhaps as difficult as any in Asia. To the south of Kashgar lies a remarkable Alpine area which, owing to its extreme inaccessibility except during a few weeks in the year, had remained unexplored, although within sight of Kashgar on the rare occasions when the atmosphere is clear. Mr. Skrine has the distinction of being the first traveller to explore and survey these unknown and probably inaccessible peaks. The chief results of his three separate journeys consist in the proof that there are two main peaks of Qungur, each of which exceeds 25,000 feet, with the lower range termed Shiwakte. It was also proved that the vegetation, including forests of firs, is akin to that of the distant Tian Shan rather than to that of the relatively neighbouring Karakoram system (*vide* "The Alps of Qungur," by C. P. Skrine, *Geogr. Journ.*, **66**, November 1925).

Among the travellers' discoveries was a "Happy Valley," which served as a base for many arduous climbs: "In this secluded Paradise of forest and river, of towering crag and pale green hanging glacier, of woodland glade and lush meadow, of natural rock-gardens filled with a hundred different kinds of Alpine flower, we spent a never-to-be-forgotten holiday." From this elysium Mr. Skrine climbed with much difficulty to a col, "and then," he writes, "I was rewarded by the finest mountain view I have ever seen. Right opposite me in the west, only 5 or 6 miles away, stood a group of glorious mountains like colossal icebergs glittering in the sun, their sides clothed with hanging glaciers thousands of feet high. It was my first near view of the mysterious and inaccessible Shiwakte, and the sheer beauty of its four 20,000-foot peaks took my breath away."

In the level plain tours were made to Yarkand, the centre of the trade with India, to Khotan, the Kingdom of Jade, and to Keriya, the *Ultima Thule* of Chinese Turkistan. From its eastern gate, a desert 900 miles wide separates this frontier town from the borders of Kansu, a fact emphasizing the vastness of the Heart of Asia. The northern side of the province was visited in the second year, and this tour, like the others, yielded a rich harvest.

To sum up, this book is of outstanding merit, the work of real travellers. Information is given on many subjects by an author who is not only deeply read, but describes what he sees and what he thinks in a masterly manner. It also shows the great advantage of the assistance that can be given by a highly gifted lady, both in the collection of information and in creating a friendly atmosphere, which is essential to success. Finally, the illustrations are superb.

P. M. S.

Among the Kara-Korum Glaciers.— Jenny Visser-Hooft. With contributions by **Ph. C. Visser.** London: Edward Arnold & Co. 1926. 9 × 6, pp. xii. + 304. *Map and Illustrations.* 21*s. net.*

Mrs. Visser-Hooft is to be sincerely congratulated on her charming and cultured account of the expedition which she made with her husband to the Hunza Karakoram in 1925. The narrative is well illustrated, and is a model of what a travel story designed for the public should be: "perspicuous, accurate, appropriate and persuasive," epithets which Sir Arthur Quiller-Couch adopted

for the hallmark of English writing. It is indeed a real pleasure to see our language handled with such grace and simplicity.

The reader cannot fail to feel himself drawn to the unknown fastnesses of the Karakoram, to share with the travellers their anticipations, and to enjoy the same moments of wonder and surprise. He must be enchanted by the beautiful descriptions of scenery, especially where the savage background has been so skilfully and so truthfully tamed by such a mountain worshipper. The vivid sympathy and understanding revealed in many of the passages dealing with the virtues and shortcomings of the native porters are themselves a tribute to the authoress. In the brief compass of Mr. Visser's lecture to us on February 22 last year, which was published in the December *Journal*, it was natural that stress should be laid on the actual geographical discoveries; it was not possible then to convey the full charm of the short Alpine summer, or the beauty of the flower-strewn moraine valleys; nor was it feasible in the time to leaven entirely the fierce landscapes on the screen—in spite of the excellence of the photographs—with the elusive atmosphere of the Karakoram. These important discoveries need not be recalled here; but in addition to a very good account of them, Mrs. Visser-Hooft has succeeded in capturing the true atmosphere. Rock and ice, sunshine and storm, laughter and trouble—six main elements of the Karakoram—have been interwoven in excellent harmony. And many of the passages, notably those dealing with the autumn flowers and colouring, are far more than a great joy to read.

Those who can for a moment cast off the spell of Mrs. Visser-Hooft's beautiful word pictures, and who wish to follow the topographical features and glacier discoveries of the expedition more closely, will regret that the map reproduced at the end is quite insufficient for the purpose. The publishers would have been better advised if they had included the one which appeared with Mr. Visser's paper in the December *Geographical Journal*. The index is also incomplete.

A few minor mistakes might be mentioned in the interests of absolute accuracy; these also are probably not the fault of Mrs. Visser-Hooft. On p. 223, the Inilchek glacier of the Tien Shan has been printed *Tuylchek;* and as regards the list of long glaciers, it may be noted that the Biafo, 37 miles long, is probably a shade longer than the Batura. On p. 160 Mrs. Visser-Hooft's explanation of "Malangi Dias" is doubtless correct; but on p. 158 there is a slight misconception. The map supplied to the Vissers was incorrect in showing the Malangutti glacier curving right round "Malangi Dias," from a point due south of that peak. This inaccuracy was not derived from any map or statement by General Cockerill, but was due to an error of map compilation, made in attempting to incorporate the later survey of the Hispar glacier by the Workmans, which has since been found to be misplaced in longitude. Sir George Cockerill expected that the head of the Malangutti glacier would be found south of "Malangi Dias" in latitude, though not in position, and a study of his paper read before the Society will show that he expected the great peak would be found to lie on the watershed at the head of the Kungyang or Lak glacier, where the Vissers have now shown it to be. On the same page, the height of this peak is given as 25,668 feet, and as this appears also in Mr. Visser's lecture and on his map in the *Journal*, it may be assumed that this height was supplied to them. In the original records of the Indo-Russian Link, and in the latest triangulation pamphlets of the Survey of India, the correct height is given as 25,868 feet.

The scientific results of the expedition, apart from the purely geographical

discoveries, are briefly summarized in the concluding chapter. When they have been fully worked out they will be considerable, and we hope to have an account of them in English. This is not the first expedition made by these explorers to the Karakoram. The reader will lay down Mrs. Visser-Hooft's book with the hope that it will not be the last, and that there will be as much to be told—and told as gracefully—when they return. K. M.

An Unexplored Pass.— Capt. B. K. Featherstone. With an Introduction by **General the Hon. C. G. Bruce.** London: Hutchinson & Co. [1926.] 9½ × 6, pp. 288. *Map and Illustrations.* 18*s. net.*

This book is the best possible testimony to the need of a Club for the Himalaya corresponding to the Alpine Club for the Swiss Alps. Here is an "Unexplored Pass" easily accessible from India, and sticking out on the map inviting exploration, and yet, for nearly forty years since the last attempt to reach it was made, no one had gone near it till Captain Featherstone had the enterprise to make the venture. But Captain Featherstone, like his predecessors, Schlagentweit, Godwin Austin, and myself, had no Alpine training or equipment. With such training and equipment there is no reason to suppose that the pass would not be crossed with comparative ease.

It was in use in former days. The guide I employed in 1887 had crossed it twenty-five years before. Since then much ice had accumulated, and we had to revert to the "old" Mustagh Pass, which we crossed and which the German Alpinist Ferber also ascended from the Indian side some fifteen years later. When, after crossing the Old (or Eastern) Mustagh Pass, I went back from Askole to see what the New (or Western) Mustagh Pass was like I was stopped by an ice-fall at about the same point where Captain Featherstone was stopped. And, being at the end of a long journey from Peking and having satisfied myself that there was no chance of a Russian army coming by that way, I did not stop to explore further.

But Captain Featherstone is quite right in recommending that an attempt should be made to cross over the main range by the New Mustagh and come back by the Old Pass. And I agree with him that the coolies necessary for this should be recruited elsewhere than from Askole. As on the Everest Expeditions, men should be specially enlisted, paid, clothed, and equipped for the purpose. And the European leaders should have Alpine training.

Government cannot be expected to initiate, finance, and organize the expedition; nor can single individuals be expected to possess the necessary money. The men who may have the training and experience may not be able to afford the expense. But a club in such cases would be of great service to men like Captain Featherstone, who have the desire to visit unfrequented parts of the Himalaya but need advice and support in order to get value from their efforts. Captain Featherstone in this case did not succeed in getting to the "Unexplored Pass," but he has written an interesting book of the adventures by the way and the peoples whom he met. FRANCIS YOUNGHUSBAND.

The Riddle of the Tsangpo Gorges.— F. Kingdon Ward. London: Edward Arnold & Co. 1926. 9 × 6, pp. xvi. + 328. *Twenty-one Plates and Map.* 21*s. net.*

The search for drugs, spices, and plants of economic value has urged men to travel throughout the ages, but it is doubtful whether such hazards and privations have been faced before for the avowed purpose of collecting seeds of plants whose claims to enrich the gardens of our homeland lie entirely in their beauty or their rarity. And yet this was the chief objective of Captain

Kingdon Ward and Lord Cawdor, whilst the solving of the riddle of the Tsangpo Gorges, which provides the actual climax of the story as here recounted, was only incidental to the trip.

The author rightly assumes that a certain amount of instruction in geography, both of Tibet in relation to the outside world and of the country itself, is necessary to introduce the reader to the area with which the story more particularly deals. This is, however, lucidly discussed in the first few pages, and then attention is directed to the formidable gorge country of the south-east, where the great rivers of Tibet in their middle courses force the barrier ranges of the Himalaya and flow down to the plains of India and China. Through this gap, some 200 miles wide and situated between the abrupt eastern end of the Himalaya, the mighty Namcha Barwa, and the north-to-south barrier ranges separating Tibet from China, the Indian Monsoon forces its way northwards along the river gorges, drenching the country and favouring forest growth as far as its influence can make itself felt. This is in striking contrast to the same monsoon wind to the west, which is wrung dry on the plateau edge and desiccates the greater part of Tibet.

It was realized that there was no possibility of entering these river gorges from the south, their great depth, unscalable precipitous sides, unnavigable rivers, and tracts of foodless and uninhabited forests prevented such an attempt. The way chosen, therefore, was from Darjeeling over the Sikkim Himalaya at the Nathu La (14,500 feet) and across the great plateau by way of Phari and Gyantse. At the Yamdrok Lake the expedition left the Lhasa road and turned eastwards, striking the Tsangpo at Tsetang at 11,850 feet altitude. No woody plants are encountered on this plateau, where exist only Alpine flowers such as poppies, aconites, primulas, and campanulas. The prolonged period of drought, fierce desiccating winds, and salty soil are too inimical to plant-life.

The second phase of the expedition was the exploration of the Tsangpo Valley from Tsetang eastwards past Tsela Dzong to Tumbatse on the Rong Chu, during which the plateau with its subarctic vegetation was left behind and a temperate Forest vegetation freely encountered. The chapters entitled "A Botanical Reconnaissance," "The Land of the Blue Poppy," "The Paradise of Primulas," give the reader some delightful pen pictures of the wonderful Alpine meadows encountered and of the strenuous work the ardent plant-collector accomplished.

The third phase was the excursions carried out from Tumbatse. June is the month for rhododendrons in Eastern Tibet, and their wealth is admirably described when the travellers crossed the Tsangpo near Pe and worked around the Doshong La and even penetrated to Pemako on the southern aspect of the Himalaya. The wealth of the flora of this province, the perpetual rain and saturated atmosphere, made a vivid impression on the travellers. In the description of this trip the reader gets a definite glimpse of the all-absorbing "Riddle." To the north the Tsangpo flows eastwards at an altitude of 9700 feet, but 25 miles southwards, in a direct line, its continuation, the Dihang, is only 2500 feet above sea-level. The mountains between rise to a height of 25,000 feet. How is this great drop of the river accomplished?

Another excursion from Tumbatse was to the Nam La, about halfway between the Doshong La and the all-dominating Namcha Barwa. The flora proved poorer in species, but the surprise was that these two valleys, only 5 miles apart, contained species peculiar to each.

Yet another excursion was made northwards along the Rong Chu to Tongkyuk Dzong, and then westwards past the lakes along the south of the

Salween Divide through Shoga Dzong to the Atsa Tso at an altitude of 14,938 feet, where General Pereira had passed only two years previously. From an altitude of 18,180 feet on the Band La the " dying glaciers " of the Tsangpo-Salween divide were seen, and an astonishing variety of flowers recorded for such a locality.

Before leaving Tumbatse finally, an intensive seed-collecting campaign was undertaken and preparations made for the final phase of the actual assault on the Tsangpo Gorges.

The story of this culminating stage of the expedition must be read in detail in order to obtain even the slightest appreciation of the difficulties encountered, the dangers escaped and the hardships undergone. There is a thrill in the chapter " The Falls of the Brahmaputra " which holds one throughout, and the reader feels that he himself comes away from the awful thunder of the water in the cavernous gorges and the heavy hanging mist of the waterfalls with the knowledge that one of the few remaining " riddles " of the Earth's surface is at last laid bare. The travellers were prevented by the impassable nature of the defile from following the whole of the middle course of the Tsangpo, and some 5 miles beyond the point to which Bailey penetrated in 1913 they had to cut across a mountain range to Payi. Near here they crossed the river below its confluence with the Po-Tsangpo, doubled back along its northern bank, and so actually saw all except a stretch of some 6 miles.

How the Tsangpo falls at the rate of 132 feet a mile over the last 14 miles of its course, and, after its confluence, falls for another 4 miles at least at nearly 100 feet a mile, was briefly told by Mr. Kingdon Ward in the *Journal* for February 1926; and for further details the reader must be referred to the book itself.

The return journey followed the former trail along the south aspect of the great Salween Divide and then southwards to Tsetang. Bleak discomfort is the prevailing tone, but the travellers were heading for home, and these thoughts served to sustain them in their wanderings across the desolate plateau against the terrible wind until they descended into Bhutan and got into touch with civilization once more at the railhead at Rangiya.

The organizing spirit which made such a journey successful is dominant throughout. Despite the physical privations, often only indicated, the plant collector always keeps the object of his mission to the fore. The story leaves on the reader's mind a vivid impression of the gorgeous Alpine meadows and the all-dominating Namcha Barwa. The fights against nature, the endurance displayed in the gorges, and the bleak return illustrate the dogged perseverance of these intrepid travellers. It is difficult to realize that the author with his facile pen and up-to-date allusions is the leader of the expedition which actually underwent the trials narrated.

There are still two stretches of this mighty river unexplored. Who will complete the picture? T. F. C.

Aus dem Jemen.— Hermann Burchardts letzte Reise durch Sudarabien. Bearbeitet von **Eugen Mittwoch.** Leipzig: Brockhaus. 1926. 11½ × 9, pp. 74 + 28 pl. *Sketch-map and Illustrations.* [*In Arabic and German.*]

Hermann Burchardt, who in fulfilment of a self-appointed task had made journeys in both western and eastern Arabia, went to Yemen for the third time in 1909, and after a stay of some duration at Sanaa, passed down the Aden road to Qataba, and thence by Taiz to Mocha. He returned to Taiz accompanied by Signor Benzoni, Italian Consul at Mocha; and the two proceeded to Ibb, whence with a small escort they set out on December 19

for Udain. The party had passed a village, Mashwara, where a Sunday market was in progress, and descended into the Wadi ed-Dor, when it was set upon, at about an hour's distance from Udain, by a band armed with stones. Burchardt and the Consul were killed, and their bodies were buried on the spot. Two of the escorting soldiers seem to have been wounded, but what, if anything, happened to the servants is not said. Plunder does not seem to have been the motive, for the property of the murdered men was handed over at once to the local administration. Thence it was recovered by a commission sent up by the Italian Government, which exhumed the bodies. It looks as if the attack had been prompted by simple hostility to strangers or by fanaticism. If by the latter, it is interesting to note that a few months previously Burchardt had been described as a Moslem in a letter from the Imam Yahya.

He posted up his notebook almost as far as the point where he met his end. Some brief entries in this are given by way of notes to the main narrative of the whole journey, now published by Dr. Eugen Mittwoch. The author of that narrative is, however, not Burchardt, but his Yemenite secretary, one Ahmad ibn Muhammad al-Garadi, who, at the instance of a well-known Italian resident at Sanaa, Signor Giuseppe Caprotti, wrote out two copies. One was sent to Burchardt's representatives at Berlin, the other to the Ambrosian Library at Milan. They are apparently not quite identical; but Dr. Mittwoch conflates them into one Arabic text, to which he appends a translation and notes, and also a collection of examples of the Sanaa dialect, compiled from Burchardt's papers.

The Secretary's narrative (he was not with the party when it was attacked, having been left ill with fever at Ibb) is, as one would expect, rather a jejune affair, confined to little more than dates, distances, names, and a record of the photographs taken by his master. Here and there a fact about buildings occurs, and more rarely a note on native customs and manners. But, in its earlier part at any rate, the narrative is so meticulous about recording names of villages, valleys, and mountains, as well as journey hours, that it should be of considerable assistance to cartographers of south-western Yemen. Though none of the tracks traversed was quite new (except perhaps the last from Ibb towards Udain), we have no such detailed knowledge of either the Aden or the Mocha tracks as would justify neglect of a new and reliable road-book. No map beyond a mere sketch is included in the present publication, but, on the other hand, it does include some sixty well-reproduced photographs of Yemenite types, life, buildings, and landscapes.

Burchardt's fate recalls closely that which befell Seetzen in 1810 in the same district of south-western Yemen. The former had made, like his predecessor, the mistake of returning on his tracks. The town, Udain, for which he was making, was noteworthy during the Great War for its insubordination towards the Turco-Imamic *régime*. Perhaps, therefore, some peculiarly vigorous tradition of chauvinistic independence is preserved there. At any rate, there is no record of a European visit to the place. D. G. H.

An Immigrant in Japan.— **T. Geoffrey.** London: T. Werner Laurie. 1926. 8½ × 6, pp. viii. + 284. *Illustrations.* 12*s.* 6*d. net.*

This is a book written in characteristic American style and from a point of view frankly Transatlantic. While purporting to deal mainly with the "Japan off the beaten tracks," it is really almost entirely occupied with the pre-earthquake experiences, domestic and local, of a lady whose husband was employed in an American business firm in Yokohama though dwelling for the most part

in a seaside suburb of that great seaport, little more than a few minutes' drive away. The frequent claims of the authoress to a knowledge of the Japanese language are difficult to reconcile with the numerous mistakes scattered throughout the text. In her descriptions of the ordinary life of a far-eastern "Treaty port" the writer dwells unduly upon its seamy side. She also gives a very frank description of the atrocious conduct of her American companions at a wayside village in the chapter entitled "The old gentleman of Jimbohara." Such incidents serve to account for the unpleasant reputation so often left behind in such places by the peculiarly objectionable type of tourist here described.

The claim of the authoress to the "distinction of being the first foreign woman" to climb the famous sacred peak of Ōyama is as absurd as it is inaccurate. At least ten years earlier a well-known English lady mountaineer had made the ascent in the company of the writer of this review. There are a number of interesting illustrations throughout the book, though we could well have been spared the frontispiece entitled "America disturbs Buddha's meditations." There is neither map nor index, and so numerous are the peculiar "Americanisms" in the text that to the uninitiated English reader a glossary would be of considerable value. W. W.

AFRICA

La Actuación de España en Marruecos.— "Juan de España." Madrid: Imprenta de Ramona Velasco. 1926. 8½ × 6¼, pp. 369. *Illustrations.*

Under the pseudonym of "Juan de España" a Spanish journalist writes vividly, as an eye-witness, of the epic events of September 1925 in Alhucemas Bay. The swift march of military operations in that month obscured to the casual world the careful work of administrative and diplomatic preparation of which these operations were the crown, but the adequate description given here shows the facts in their true relations. For the first time a full account is published of the administrative changes which concentrated in a single bureau in Madrid the direction of Moroccan affairs and so made possible unity of conception and rapidity of execution, the former being greatly extended in sphere by the diplomatically-prepared cooperation with France. A panoramic view of Alhucemas Bay and a long extract from the Operation Orders for the landing add to the interest of this section of the book.

The moment has appeared suitable to the author to proceed to a review of the whole work of Spain in her North Moroccan zone, and this review is welcome as a useful supplement, based on the most recent statistics, to the only description of the zone available in English—His Excellency the Spanish Ambassador's communication to the Society in February 1920.

Nothing seems to check the rapid growth of Melilla, in 1900 a small town of 4000 inhabitants gathered under the shelter of the fortress, to-day a city of some 52,500 inhabitants spread out over the area of Spanish sovereignty. This sensational increase does not appear to be explained fully by the mineral exports (about three million metric tons in the twelve years from 1914 to 1925) and the importance of the hinterland alone; Huelva, in Spain, has a population of under 40,000, although it has exported on occasions nearly as much ore in one year as Melilla in twelve, while the attraction of the hinterland cannot as yet be fully operative. The existence of the military base at Melilla has perhaps played a considerable part in its growth, and "Juan de España" is probably correct therefore in supposing that the town has already reached the period of maturity. Quick growth in the near future appears to him to be

more likely in the west of the zone, where Ceuta is rapidly preparing harbour improvements against the day when improved communications with the interior, added to the great natural advantages of the site, may enable her to compete successfully as a commercial port with her rivals on the Straits. A scheme has already been adopted for connecting Ceuta with Alcazar by building a new railway to link up, at one end with the existing Ceuta–Tetuan line, at the other end with the Tangier–Fez line at Biban, after the main watershed of the Yebala has been crossed at the Fondak de Aïn Yedida.

The effect of these improvements and of those at Larache and elsewhere in diverting or increasing the current of foreign trade remains to be seen; the significant fact for the British reader at present is the serious decline of this country's trade with North Morocco. In 1914 Great Britain supplied over 30 per cent. of the imports to the Spanish zone and took about 12 per cent. of the exports, while in 1924 the corresponding percentages were approximately 9 and 8.

Behind the more obvious military and engineering work undertaken by Spain in her zone, a quieter and perhaps, in the long run, more important work of re-afforestation and agricultural education has also been going steadily forward. Experimental stations have been set up to test the resistance of trees and plants to the climatic conditions; nurseries at Larache and on the Rio Martín supply young trees for the fixation of the large dune-tracts and for the repopulation of the deforested areas; the important experimental work in Dry-Farming and in Sub-tropical Agriculture in general, carried on at official stations in Spain, has also been extended to the protectorate. No one who knows the excellent work of the officers of the Agronomic Service can have doubts of the ultimate effect of their influence in Morocco.

It should be mentioned that "La Actuación de España en Marruecos" is available also in English and French translations. R. A.

An African Eldorado: The Belgian Congo.— T. Alexander Barns. With an Introduction by **Sir Louis Franck.** London: Methuen & Co. 1926. 9 × 6, pp. xv. + 229. *Maps and Illustrations.* 15*s. net.*

In 1909 the administration of the vast territory of the Congo Free State, over 900,000 square miles, containing more than 12,000,000 peoples, passed from the sovereign to the Belgian State, giving the Belgian Government the opportunity to repair an evil it had wrongly tolerated too long, said M. Emil Vanderwelde, the Belgian statesman. Four years later, in 1913, the change in policy was inaugurated to the satisfaction of the Congo reformers. Then came the Great War. As a result of the Treaty of Versailles Belgium obtained a mandate for the Ruanda and Urundi districts, and became responsible for the well-being of an additional 5,000,000 peoples.

The Belgian Congo has great natural advantages. Over 10,000 miles of navigable waterways intersect its rich fertile soils, which produce a variety of products in great demand by the more advanced peoples of the world—rubber, oils, coffee, cocoa, sugar, rice, sisal-hemp, cotton—and which support countless herds of cattle. The rivers themselves abound in edible varieties of fish. The ridges of the Congo basin contain mineral wealth in abundance. Gold is obtained in the north from the Kilo and Moto mines; copper from the malachite hills of Katanga—the richest copper fields in the world; diamonds from Kasai; and the radium obtained from the uranium ores of Katanga and Chinkolobwe gives Belgium a virtual monopoly of this unpriceable metal.

The development of the Congo basin proceeds apace. According to all

accounts the administration of the territory bears favourable comparison with that of neighbouring British territories. But nothing appears to have been done for the mandated territory of Ruanda and Urundi. The physical barrier of the Great Rift hampers all efforts to bring this populous district within the Congo economic scheme, showing clearly the inconvenience of the present boundary which separates it from its natural outlet through Tanganyika.

The vast unrealized mineral wealth, the potential agricultural wealth in crops and domestic stock, leads Mr. Barns to describe the Belgian Congo as "An African Eldorado" to which all young Europeans in search of fortune should turn their eyes. For the young fortune hunter this volume should be an inspiration. But this is the least attractive aspect from which to regard it, and Mr. Barns does himself and his art a disservice by the descriptive paragraph on the cover. It may be true that there will be a quick and lucrative return on capital invested in the Congo, but there are far better reasons for the presence of white men in the country. They can emulate "les pères blancs" and other devoted missionaries who, by their works and their methods, have brought real civilization to the African native, be he pigmy or Watusi giant, and have given a necessary lead to government, a lead which is now being followed assiduously.

In this wonderful land, parts of which are exceedingly beautiful, no part of which is without abiding interest, white men can assist the natives to traverse centuries of time in a few years. They can be liberators, if they will, in the best sense of the word, assisting the natives to preserve all that is valuable in their own culture while imbibing all that is best in ours. But to do this they must understand the natives.

Those who wish to understand the African peoples, to appreciate the difficulties of the white settler, to realize the tremendous battle which man is ever waging in the tropics against human, animal, and plant diseases, to capture the environment and to enjoy its grandeur and its beauties, should read this volume. A. G. C.

Letters from the Gold Coast.— H.H. Princess Marie Louise. London: Methuen. 1926. 9 × 6, pp. viii. + 240. *Illustrations and Sketch-map.* 16*s. net.*

This volume contains some of the best letters from a colony we have ever had the pleasure of reading. The minutiæ of tribal and administrative problems are perhaps recorded in rather too great detail for a reader without direct acquaintance with the Gold Coast, but the account which the letters give of Princess Marie Louise's protracted tour of the country is none the less one which can be followed with the greatest interest by the general public. To those who live in the country the book will prove how deeply appreciative Her Highness and her correspondent were of everything that happens there. The numerous excursions into ethnological and archæological matters are, moreover, worthy the attention of the learned; we have often had occasion to speculate upon the amount of good material that has been neglected by students conducting their researches only into obviously scientific places. We cannot here do more than merely refer them to the stories of Ananse the Spider (pp. 130, 146, and 197). No one could fail to be touched by the very gracious acts of the author through her tour, and especially by the incident connected with the medal ribbon of ex-soldier Bassana Grunshi. But one aspect of the book is commendable above all others, namely the unstinted, but only merited, admiration expressed for the colonial civil servant and for his perhaps even more wonderful wife. Is it to the former or to the latter, or haply to both, that in addition to

our Empire we owe that strange sense of the fitting and dramatic which come as such a surprise to the more theatrical foreigner educated to believe us an undemonstrative nation? We wonder whose idea it was, that night after the ball at Kumasi when Princess Marie Louise was leaving the north on her way home, to post a chain of buglers in the bush along the railway line, successively to sound the "Hausa Farewell" as the train bore her away from Ashanti.

F. R. R.

AMERICA

Ancient Cities and Modern Tribes.— Thomas Gann. London: Duckworth & Co., Ltd. 9 × 5¾, pp. 256. *Illustrations.* 21*s. net.*

In the present volume Dr. Gann continues the story of explorations in the area of ruined Maya cities, with which he has already dealt in two previous books; the work of 1926 is recorded here, with no less zest than before. The lover of books of archæological discovery will take up this work as the continuation of a serial story of adventure.

Dr. Gann has, as a matter of fact, something new to relate, in addition to his thoroughly entertaining description of a visit to the fine site of Ichpaatun, on Chetumal Bay, and to the "Cave of Flowers," Loltun, in Yucatan. The accounts of both of these journeys make excellent reading, but the reader's interest grows to envy when he reads of a "new" abandoned city, the deserted Coba, of which the author learned through the recent publication of a Spanish version of a Maya historic document, and for which he sought successfully.

Coba lies some 50 miles east of the ruins of Chichén-Itzá; the latter has been photographed and described ever since the visit of Stephens in the middle of the nineteenth century, yet Coba had, apparently, never been seen by an archæologist until Dr. Gann made his way there. The road, nevertheless, was well marked enough, for a great causeway, paved with limestone blocks and raised above the tropic bush, led to what must have been a great ceremonial centre. The position as described by Dr. Gann is magnificent, the elevated buildings "filling up almost the whole of a little isthmus separating two beautiful clear blue lagoons"; the Caribbean Sea is but 30 miles away to the east, but the ruins "are situated in the least known and most sparsely populated region of Yucatan," with the nearest village "twenty miles away, through an almost trackless wilderness, traversed only by chicleros and Indian hunters."

The complex of buildings was, of necessity, surveyed only in a cursory manner on this occasion, for the simple but sufficient reason that "we had barely two days' provision left"; but flat-roofed buildings, whose walls were covered with brightly coloured stucco, surrounded by the characteristic Maya room of the narrow arched type, were seen amongst the groups. "At one place," says Dr. Gann, "a flight of stone steps descended from a flat-topped mound to the lagoon margin, and was continued as a pavement along the floor of the lake itself, forming a delightful bathing-place and wharf for canoes, for both of which purposes it was doubtless used by the ancient inhabitants."

Obliged to leave this pleasant spot, to which it is hoped the scientific explorer will return for complete investigations, Dr. Gann pursued his journey to pay a flying visit to Lubaantun, and to spend some days at the famous ruins of Copan, just across the Guatemalan border of the Republic of Honduras.

Dr. Gann writes easily of day-to-day experiences, and he possesses the advantages of old residence among a Maya population, and knowledge of travelling and camping conditions in lovely but sometimes forlorn country where the ordinary white man, if separated from the trappings of civilization, would find himself in serious difficulties.

L. E. E.

The Land of Magellan.— W. S. Barclay. London: Methuen & Co. 9 × 5¾, pp. 240. *Twenty-eight Illustrations and Three Maps.* 12*s.* 6*d. net.*

Mr. W. S. Barclay is a recognized authority on the subject of transport in South America; but if he looks upon mountains and deserts with the eye of faith that sees railways crossing chasm and plain, and if rivers suggest bridges, it is not because he does not also behold the romantic story of vast and untamed regions. And it is with romance rather than railways that he deals in the present entertaining and well-presented volume, although he makes the point that even now "in the last resort it is the sea passage round the Horn, or through Magellan's Straits, that governs freight rates quoted on trans-continental railways in North America."

"The northern routes across America are like gates that are pressed open wider each year to accommodate the increase of travel and commerce, but which may on emergency be closed. In the final arbitration of trade or of war, the sea-route by the land of Magellan holds the key to the Pacific, for . . . the Cape Horn passage is the only one, at all times and under all circumstances, politically and actually free to vessels making their way into either ocean."

The whole story of Magellan's magnificent voyage is told with attention to historical detail and to the economic results of the return of the little *Vittoria*, spice-laden, from the circumnavigation of the globe; and the author proceeds to explain the effect of the finding of the southerly water route upon the plans of Spain. Drake's discovery of Cape Horn, the unfortunate colonizing attempt of Pedro de Sarmiento in the inhospitable Magellanic regions; the voyage of Cavendish, and of the Dutch navigators, are followed by the odd story of the fabulous "City of the Cæsars," part of the romance of Patagonia that, says Mr. Barclay, received its death-blow only in 1902, when the Chile–Argentine boundary was fixed.

Every one who knows the native tribes of South America will agree with all that Mr. Barclay says of the unhappy folk of the Magellanic country, losing personality and vitality after contact with the civilization of white races; the numbers of the Yaghans, he says, have dropped in three generations to vanishing-point; the Onas, in less time, from 2500 to about 400; while to-day there are no more than 800 Alacalufs. "It cannot be long now before camps of the Fuegian Indians become as scarce as the seal-rookeries on the outer islands of Cape Horn, and their final disappearance will cause almost as little comment."

Perhaps the most interesting chapters of all are those dealing with the experiences of the author in the fringe of the region, little known and almost never described; he is at home in the region of "rainbow gold"; when fishing off Ushuaia; or when in Beagle Channel and in lonely Lemaire Strait; but to the ordinary traveller all the region is, as Mr. Barclay says, still almost *terra incognita* beyond the boundaries of the great sheep stations, for "hardly one of its clustered peaks has yet been scaled, and these look to one another across a land where forest, stream, and fell mingle in bewitching confusion."

Mr. Barclay's succinct and critical style adds to the value of a thoroughly competent volume. The illustrations are good, the index adequate, and the map exactly what is needed. L. E. E.

AUSTRALASIA AND PACIFIC ISLANDS

The South Seas of To-day: being an account of the Cruise of the Yacht "St. George" to the South Pacific.— Major A. J. A. Douglas and **P. H. Johnson.** London, New York, Toronto, and Melbourne: Cassell

& Co. 1926. 9 × 6, pp. xiv. + 296. *Thirty-nine Illustrations and Three Charts.* 21*s. net.*

Sea-girt Jungles: the Experiences of a Naturalist with the "St. George" Expedition.— C. L. Collinette. London: Hutchinson & Co. 1926. 9 × 5½, pp. xiv. + 274. *Sketch-map and Illustrations.* 18*s. net.*

Both these books give some general account of the voyage of the party of naturalists who left Dartmouth in the spring of 1924, in the yacht *St. George* for research work in some of the smaller Pacific islands, which, in that they lie outside the regular track of steamers, have been less closely studied by scientific folk. The scheme of the expedition was excellent; and it is much to be regretted that circumstances—chiefly inadequate financial support—brought the expedition to an end before it had reached more than a very few of the less known islands which it was intended to study.

From Dartmouth the track followed was by Madeira, Trinidad, and through the Panama Canal, which places no longer offer any especially novel experiences to scientific explorers. But from the Pacific end of the Canal some of the smaller islands lying off that part of the coast were visited, and these gave some opportunity for good work to the naturalists. After that the yacht passed to the Galapagos Islands, which, despite the fact that so much has been written about them—especially by Darwin and the officers of the *Beagle*—remain, and must always remain, of quite exceptional interest to naturalists. The Marquesas Islands and the Tuamutu Atolls were also visited; and, after a stay at Tahiti, the more rewarding Austral Islands and "Lonely Rapa" were examined. And then the long homeward journey was necessarily begun.

In the book above first named Major Douglas—who seems to have been the chief originator of the expedition—and Mr. P. H. Johnson, each responsible for about half the chapters, have given a general account of the incidents of the voyage, Major Douglas dwelling with somewhat more appreciative care than his colleague on the scientific observations made. But it is distinctly stated in the Introduction to this book that the scientific results must be looked for "in the journals and reports of the various institutions that received the numerous specimens that were brought back."

In the second book above named Mr. Colinette, Fellow of the Entomological Society, makes no attempt to tell the story of the whole expedition, but has jotted down, from time to time, some really vivid notes of his experiences on the occasions when he was able to hunt for butterflies, moths, and beetles in places which were just on or beyond the fringes of civilization. For instance, his account of the night he spent alone, camped far up in the almost pathless jungle which clothes the side of Mount Temetio (Hiva Oa), the highest mountain in the southern group of the Marquesas Islands, makes delightful and almost thrilling reading; as does the story of what he saw during the three weeks which, with some of his colleagues, he spent when "marooned" on the little island of Coiba, 300 miles off the coast of Costa Rica: almost uninhabited when visited by Mr. Scoresby Routledge in 1916, this island is now invaded by the civilization implied in its having become a convict station from Panama.

Of the two books, that by Mr. Colinette is very distinctly of greater scientific interest; but neither adds much to geographical knowledge. Both books are provided with good indexes, with but poor maps, and with a large number of photographic illustrations, some of which, especially those in Mr. Colinette's book, are interesting and valuable. E. im T.

MATHEMATICAL AND PHYSICAL GEOGRAPHY

Aims and Methods in the Study of Vegetation.— Edited by **A. G. Tansley** and **T. F. Chipp.** Published by the British Empire Vegetation Committee and the Crown Agents for the Colonies. London: 1926. 9 × 6, pp. xvi. + 384. *Illustrations.* 12*s.* 6*d.*

This is the firstfruit of the activity of the British Empire Vegetation Committee, set up as the result of the first Imperial Botanical Conference, held in London in 1924, and is intended " to give actual and potential workers a statement of what is meant by the study of vegetation, . . . together with some account of the methods which field workers have actually used." In addition to the editors a number of other investigators have taken part in its production. It is admirably illustrated, contains full references to the literature, is adequately indexed, and constitutes a very important addition to existing books dealing with plant ecology. As it is a quasi-official publication, certain to be re-issued as it runs out, we propose to limit this notice to some suggestions which might be considered for future editions.

The book is divided into three Parts, named successively General, Regional, Types of Vegetation. The basis of the distinction between the articles in Parts II. and III. is by no means obvious. It is presumed that the word " Regional " as applied to Part II. is meant to imply t[1] at this section is devoted to the methods of study applicable to the different climatic regions of the empire, while the articles in Part III., which are certainly what the geographer would call Regional, present the results of investigations. But even this distinction does not hold. For example, Dr. Dudley Stamp's article in Part I., entitled " Some Special Aspects of Vegetation Survey in the Tropics," gives an account of his own work in Burma, in addition to discussing suitable methods of survey in such tropical regions. On the other hand, Prof. J. W. Bews' article in the same part on " Vegetation Study in Sub-tropical Regions " consists only of general notes, with no definite reference to sub-tropical regions beyond the fact that his own work has been chiefly done in sub-tropical South Africa. We would suggest that a rearrangement of material in these two Parts would economize space, and would also result in great gain from the point of view of logical and orderly development.

Again, since the book has an immediate practical aim, it would seem to be desirable that Part I. should give only as much of the theory of the subject as experience has shown to be necessary for the field worker, and that the special articles should illustrate and exemplify the general statements made in it. From both points of view, we would suggest, modifications are desirable. On pp. 21 *et seq.* an account is given of Raunkiaer's Scheme of Life Forms, and it is stated that the " spectrum " of the various life forms (*i.e.* the percentage distribution of the different classes in the whole flora) gives an excellent key to the climate. But the subject is not raised again throughout the book, save for a passing reference on p. 272, and though Dr. Chipp, who as one of the editors is presumably in part responsible for the General section, contributes a special article on West Africa, with a somewhat detailed " Physiognomic Classification," there is no reference to Raunkiaer's Scheme, not even a cross-reference to the previous discussion. There is indeed virtually no reference to climate at all in this article, not even to the conditions which appear to control the distribution of forest and grassland. Curiously enough, also, though the climatic factors are fully discussed from the general standpoint in Part I., by Dr. Stamp in his article in Part II., and by Prof. Troup in his article on Indian forests in Part III.—where the treatment of monsoons is a little

"old fashioned," especially as regards the cool season rainfall of the Madras Presidency—most of the authors ignore the subject entirely, and there is a flat contradiction between the editorial statements on p. 99 and those of Dr. Stamp on pp. 241–2. On the former page it is stated that in the hotter regions of the world the total amount of rainfall in the year influences the vegetation to the extent that the heaviest rainfall corresponds to the wet monsoon forest, and a much lighter one to climatic grassland, while the correspondence between rainfall and vegetation is much less marked in cooler countries. But Dr. Stamp states emphatically that "woodland does not pass into grassland merely by decrease of rainfall," and that, while parts of Burma have the same total rainfall and temperature range as parts of the Sudan, there is no natural grass-land in Burma because it has "a woodland climate."

This particular contra liction is but one illustration of the enormous editorial difficulties involved in the preparation of so comprehensive a book. In any re-casting, however, we think that it would be an improvement to have cross-references from the general to the special sections, and the editors would be well advised to have the paragraphs relating to climate revised by a climatologist, and to insert references to books on climatology. M. I. N.

GENERAL

Leaves from a Viceroy's Note-book and Other Papers.— The Marquess Curzon of Kedleston, K.G. London: Macmillan & Co., Ltd. 1926. 9 × 6, pp. vi. + 414. *Illustrations.* 28*s. net.*

The literary executors of the late Lord Curzon found among his papers a collection of essays intended to make a sequel to his 'Tales of Travel.' In publishing them they deplore the absence of the final polish which was so characteristic of everything that Lord Curzon wrote, yet commend them to the reader for their charm, gaiety, information, and style. They are indeed, in the longer papers, packed full of information admirably arranged, the fruit of that passion for inquiry which so greatly distinguished Lord Curzon as a traveller, and did not fail in his later political life. Though he declares that "in a descriptive article nothing is so detestable as history," the historic background is there all the time as richly figured as in a chapter of Macaulay. The two chapters on the Monasteries of the Levant, written as a commentary on the celebrated account of them from the pen of his kinsman, display his admirable blend of historical and geographical penetration: the account of Hué, capital of Annam, his equally dexterous combination of politics and archæology.

The most important chapters of the book, roughly a quarter of the whole, deal with the North-West frontier of India, which he visited as a Member of Parliament and correspondent of the *Times* only a few years before he ruled it as Viceroy: the intervening years seeing the most acute of the frontier troubles. The younger officers whose methods he studied and whose ideas he absorbed in 1894 had—those of them who survived the adventures of the years between—the satisfaction of serving as seniors under a young and enormously capable and energetic Viceroy who knew the frontier as widely, if not as minutely, as they did. Many of them are still living to read with satisfaction his vigorous defence of the frontier policy they administered, and his eloquent appreciation of their work and its happy results for the peace and well-being of those wild and magnificent regions.

There are passages in the Pages from a Diary of word painting in the grand style; pungent remarks on his forerunners in travel, as upon Froude, who was pressed with damnable iteration not to miss the Yosemite Valley, without

arousing the concern of that implacable man. But examined critically the style of the writing is perhaps a little over-loaded, and we miss that compelling power of language that made Lord Curzon so formidable in debate, and so difficult to contest in council or negotiation.

In the forefront of their commendation to the reader his literary executors put his charm and gaiety. Now, in writing of his earlier book of travel the reviewers detected a schoolboy element in his humour rather strangely out of keeping with the mature productions of so great a man, and there are a few passages in the present book which editors without his express authority for publication might have thought it more discreet to suppress or postpone for a while, such as the curious account of the valet who impersonated the Viceroy more than once on occasions of ceremony or the satiric story of the visit to Goa. The chapter called "The Old Persian" is a remorseless identification of the characters in Morier's *Haji Baba* with the leading Persians of Morier's acquaintance—an interesting private exercise, but surely a little unkind even so many years later: informing, and possibly useful, but not charming.

The book is abundantly illustrated with excellent photographs mostly attributed to various press agencies, though in at least one case clearly identifiable as the work of a recent traveller: compare the plate facing p. 196 of the book with the plate facing p. 388 of the *Journal* for November 1925. There are no sketch-maps, though one is badly wanted to illuminate the chapters on Gilgit and Chitral.

The "Arcturus" Adventure.— W. Beebe. New York and London: G. P. Putnam's Sons. 1926. 9½ × 6½, pp. xx. + 439. *Illustrations and Maps.* 25*s. net.*

The *Arcturus*, a finely equipped oceanographical yacht of 2400 tons, was sent by the New York Zoological Society to explore the Sargasso Sea and the Humboldt Current. In this volume Mr. Beebe gives a popular but yet scientific account of the five months' cruise. He has produced a fascinating volume fully equal in interest to his previous book on the Galapagos (reviewed in *Journal*, **64**, p. 259), and even better illustrated than that beautiful volume. A few more books of this nature should succeed in popularizing the science of oceanography and awakening a lively interest in the wonders of ocean life. After a short cruise in the Sargasso Sea, where the waters proved too rough for the American oceanographers, the *Arcturus* went through the Panama Canal in search of calmer seas, and devoted the remainder of her cruise to the waters between Central America and the Galapagos Islands, with a visit to Cocos Island. On her return she paid some attention to the submerged Hudson Gorge, south of New York. No trace of the Humboldt current was found about the Galapagos, but a curious current rip was met to the south of Cocos Island, caused by the convergence of two warm westward-flowing streams. It was a paradise for the zoologists, abounding in animal-life and drifting *débris*, and frequented by many birds. The equipment of the *Arcturus* included many ingenious devices, including a bow "pulpit" that could be lowered to the level of the water, and a boom walk not unlike the pirates' plank in construction. But the plan of trailing plankton nets from a boom on the weather side was not the novelty Mr. Beebe claims for it, but has been in use for some thirty years. The most striking piece of equipment was a 60-lb. diving helmet, which, lying on the shoulders by its weight, enabled a man to descend in shallow water to watch the animal-life and move freely, unencumbered by a diving suit. An air-pipe was of course attached. This device furnished the material for many of the pages of graphic description that are

a feature of the book. One interesting result of the expedition was the discovery of an albatross rookery on Hood Island, and we are also given a full account of the story of buried treasure on Cocos Island. But from end to end the book is full of charm and interest, enhanced by the excellent photographs and many coloured plates. R. N. R. B.

Sir Cornelius Vermuyden.— J. Korthals-Altes, F.Hist.S. (Ned.). London: Williams & Norgate; The Hague: W. P. van Stockum & Son. 1925. 10 × 6½, pp. xii. + 202 + 208. *21s. net.*

This is a history of the life-work of Sir Cornelius Vermuyden, the great Anglo-Dutchman and authority on land reclamation and drainage. The author describes the work of Vermuyden in draining the fen districts in England. In the first chapter he gives a brief history of the parts of the counties of York and Lincoln in the neighbourhood of the Humber and the Trent, the period covered going back to 44 B.C., and the various efforts at drainage and reclamation are briefly mentioned.

In chapter 2 the history is brought up to the date when Cornelius Vermuyden was summoned to England by the King in 1621 owing to an inundation following the overflow of its banks by the Thames near Dagenham. The various difficulties and vicissitudes met with by Vermuyden are then described somewhat at length, and following this the author sets forth his own views on the present conditions of drainage in England, and makes suggestions for the future. A *résumé* of the drainage legislation of Holland is also given.

The book should be found of use by those interested in the history of the reclamation of marsh lands in England, but its value as a reference work is detracted from by the absence of an index, which makes it somewhat difficult to use, considering that there are 202 pages of letterpress, followed by 208 of appendices, the only guide to which is to be found in a brief list of contents occupying about half a page. J. S. O.

Travel and Adventure in Many Lands.— Cecil Gosling. London: Methuen. [1926.] 9 × 6, pp. ix. + 294. *Illustrations.* *10s. 6d. net.*

In Many Parts.— Lieut.-Col. W. P. Drury, C.B.E. London: T. Fisher Unwin. [1926.] 9 × 5½, pp. 251. *12s. 6d. net.*

The title of Mr. Gosling's book is well justified by its contents. Before he was twenty years of age he had acquired several European languages and had already visited Guatemala, where as horseman, sportsman, and budding diplomat he had some exciting advantures. His next sphere was South Africa—and active service with the British Bechuanaland Police in Matabeleland. His reminiscences of this period of South African history are interesting, but his stay there was cut short by ill luck, and he returned to England, only however *en route* for Spanish America again. Entering the Consular Service, he rapidly advanced, from Vice-Consul at Cuba prior to the Spanish-American war, and Consul in Paraguay, to Minister at La Paz. In each country he endeavoured to see all that was to be seen, undeterred by hardships or dangers, from which his coolness and determination always extracted him, and to understand the life of the people. He gives first-hand accounts of the "New Australia" settlements in Paraguay, and of the rubber estates of the upper Amazon basin. His style is frank, unembellished, and often outspoken. One or two small slips may be accounted for by the fact that he writes from memory.

To rival this book in the number of adventures or the range of travel would be difficult. Colonel Drury would not make this claim for his, for his title

refers rather to "rôles" than to "foreign parts." As a Marine, however, his service has taken him to the Mediterranean, the East, and the Antipodes; but the early part of his book is interesting as a description of life in the Marines, ashore and afloat against many fleeting backgrounds, in the closing years of the last century. Later Colonel Drury played other parts, as author, playwright, and strong supporter of Lord Roberts' National Service Scheme, until the war brought him back to his earlier sphere. His reminiscences are well told, with a pleasant touch of humour.

Excursions and Some Adventures.— Etta Close. London: Constable & Co. [1926.] 9 × 5¾, pp. viii. + 296. *Illustrations.* 12*s. net.*

Though Miss Close's excursions range from Spain to Japan, from Norway to Morocco, the main interest throughout are the personalities of the authoress and her mother. Often unaccompanied and without definite plans, the travellers always displayed resourcefulness and high spirits, and these reminiscences are written in the same mood. "Excursions" is a more modest title than some might employ, for even to-day many of the journeys would be off the well-beaten track, and were naturally more so at the beginning of the century. Miss Close is really more intrigued by the people she encounters than interested in the regions she traverses, and she is most entertaining when describing the Shereif of Wezzan, the English manager of a manganese mine in Asturias, or the millionaire from Nome.

THE MONTHLY RECORD

EUROPE

Movement of Population in France, 1881–1921.

THE question of the population of France has received much attention lately; a further study on a regional basis of the census returns for 1881 and 1921 by MM. A. Demangeon and M. Matruchot is published in the *Annales de Geographie* for November 1926. The results are based upon the returns for each canton, arranged in several groups of increase and decrease. Excluding Alsace-Lorraine, 617 cantons showed an increase, and 2344 a decrease. In each of the departments of Alpes Maritimes, Basses Alpes, and Lot, two cantons had decreased 50 per cent. The homogeneity of these areas is brought out by the departmental figures: in eighteen departments all cantons, or all but one, had decreased; only in six departments had more than half the cantons increased. There are six main areas of depopulation. The largest and most uniform of these are the Aquitaine basin, and Eastern France from the Meuse and Ardennes to the Doubs, from the Nièvre to the plain of Alsace. The former, comprising mainly the middle basin of the Garonne and stretching to the Central Pyrenees, is a rich and fertile land, which is going out of cultivation through the decreasing birthrate, and in spite of the influx of Spanish, Italian, and other labourers. North of Cahors, fourteen cantons have decreased more than 40 per cent., while Cahors itself has fallen from 15,524 to 11,866 inhabitants. The Eastern area, too, the calcareous plateau, is a fertile country: here the decline is attributed to the decay of corn-growing through foreign competition, the turn-over to pasture, and the antiquated and wasteful land system. Other regions showing large but not so striking decreases, are Basse Normandie (Manche, Orne, Calvados occidental), with a low birth-rate, a change from cultivation to pasturage, and decaying domestic industries; the devastated

areas, where twelve cantons have decreased more than 50 per cent.; the Alpine area, with two centres of maximum depopulation, between the Durance and the Côte d'Azur, and between the Durance and the upper Drac; and, finally, the Massif Central. This last area shows several internal variations, apart from its urban centres. Thus Cantal and Lozère, though both mountainous and poor, show slight decreases, through high birth-rates and peasant tenacity. Greater decrease has occurred between the Loire and the Saône, caused by urban attraction and in some degree by the abandonment of vineyards; in the eastern Limousin and Marche areas, a poor land with a high birth-rate; and in the southern Central Massif, where the conditions are similar.

The areas of increase, apart from small urban and industrial centres, are four: The industrial region of the north around Lille, Arras, and Maubeuge; the Paris basin; Western Brittany—"Breton Brittany," where the birth-rate is high; and the coastal areas in general. The increase of population along the Northern, Atlantic, and Mediterranean coasts, with but few gaps, is one of the striking results of the survey. It is to be hoped that the authors will succeed in preparing similar maps for the years 1801 and 1846, which would show the effects of industrialization.

Swiss Hydrographical Researches: Lake of Constance and R. Maggia.

A project for controlling the level of Lake Constance and its outflow is discussed at great length, with many diagrams and maps, in the Swiss *Mitteilungen des Amtes für Wasserwirtschaft*, No. 20, 1926 (Karl Koberlt, "Die Regulierung des Bodensees"). Plans for securing protection from floods through the rise of level of the lake had been discussed frequently, but only in recent years have proposals been put forward which, in addition to securing this, would also provide hydro-electric power and improve the navigation of the Rhine. The study opens with a detailed hydrographical analysis of the lake, based upon records extending over a century, and on work specially carried out, such as charting the Konstanzerbucht, preparing profiles of portions of the Rhine, and carrying out levellings. The problem is to lower the high-water mark of the lake without at the same time greatly increasing the total outflow or reducing the low-water mark appreciably. The first limitation is of course dictated in consideration of the lower Rhine valley. The proposed works include the deepening of the Rhine bed between the Upper and Lower Lakes, and between the Lower Lake and Schaffhausen, in order to allow as much water to escape at the proposed new lake-level as flows out at the highest level at present. Then the flow of the lake would be controlled by a dam across the Rhine near its exit, either at Hemishofen or at Rheinklingen. The average yearly difference in the level of the lake is 2·08 metres; the difference between the highest and lowest observed levels is 3·98 metres. This dam would be provided with locks for ships, and would also be the site of the power installation. It is thought that by this means the high level of the Lake could be reduced by 70–80 cm., and that the average annual high-water level would not approach within 50 cm. of the danger line. Some 2100 ha. would thus be saved from floods. The total initial outlay is calculated at 15 million francs, and the time for building at six years.

Another publication of the same Department deals with the growth of the delta of the Maggia in Lake Maggiore (H. Bircher, "Il delta della Maggia nel Lago Maggiore"). The work was carried out at the beginning of 1926, and full details are given of the methods of obtaining the data for the seventeen profiles obtained. A certain number of soundings from a survey made in 1890 permitted a comparison to be made. From this somewhat limited detail,

it is calculated that in the thirty-five years approximately 20 million cubic metres have been deposited almost entirely by the Maggia, or approximately 570,000 m.^{3} per year. For the basin of the Maggia this amounts to 612 m.^{3} per km.^{2}, compared with the previously calculated figure for the Rhine basin above Lake Constance of 456 m.^{3} per km.^{2} (see *Geogr. Journ.*, 1924, **63**, pp. 454–5). The report is accompanied by two bathymetrical maps on the scale of 1 : 7500.

Estonia.

The Institute of Geography of the University of Tartu (Dorpat) is actively engaged in gathering the material for a sound knowledge of Estonia. We have already noticed (*Geogr. Journ.*, **66**, 174) a valuable general essay by Dr. M. Haltenberger, "Gehort das Baltikum zu Ost-, Nord-, oder zu Mitteleuropa?" He has recently published a more detailed study on Estonia, "Landeskunde von Eesti" (Publ. Inst. Univ. Dorpat. Geogr., 6–10). Some of the more general points may be noted here. Geographically, Estonia is not sharply defined from the surrounding regions; it is a corner of the Russian palæozoic tableland, of which the surface relief here is due almost entirely to the glacial period. Characterized by drumlins, moraines, and eskers, its average elevation is 50 metres. Approximately one-sixth of its area is swamp and moorland, and there are one thousand lakes, few of which have an area of more than 1 qkm. This being so, the writer is at pains to show that the community has an ethnological unity; of the total population, which just exceeds one million, 87 per cent. are Estonians. The residue, mainly living in the towns, are Russians, Germans, and Swedes, in that order of importance. The people are predominantly agriculturalists; in the south-east circle of Petseri, the zone of glacial accumulation, the percentage is as high as 90, the highest industrial population being in Harju, 26 per cent., in which Tallinn (Reval) is situated. As elsewhere in Eastern Europe, a feature of the post-war social legislation has been the transference of landed property to the peasants. At present 68 per cent. of the land belongs to peasant proprietors. It is perhaps too early to trace the effect of this change upon production. Apparently the average yield of potatoes and autumn rye is now lower than in pre-war years, while that of oats and barley has increased.

Possessing few minerals of economic importance, Estonia's industries are agriculture, dairy and cattle farming, and forestry. The main crops are rye and potatoes in the western islands and northern districts, and oats, barley, and flax in the southern. Cattle are kept mainly in the moister western regions. Forests cover 40 per cent. of the area. Thus of the exports, flax and other fibres form 23 per cent., timber and wooden goods 22 per cent., textiles 18 per cent., dairy produce 15 per cent., and paper 8 per cent. Most of the dairy produce goes to Germany, and practically all the timber to Great Britain. It is more striking that 34 per cent. of the imports are foodstuffs. That the economic position is improving is evidenced by the reduction of the adverse trade balance from 36 million gold krone in 1923 to 3 million in 1924. In 1924 the features of the total foreign trade were, first, its rapid growth—it had increased three and a half times since 1920; secondly, the decreasing proportion of transit trade, from one-third in 1922 to one-fifth in 1924. Most of this originates in Russia, so that its decrease reflects the improving position in St. Petersburg as a port of export. In pre-war days, Tallinn was specially developed by Russia, and it remains still the economic centre of Estonia. It is not altogether sound that in an essentially agricultural country over one-tenth of the population should reside in Tallinn. This Dr. Haltenberger recognizes and points out that the

basis for the future prosperity is in agriculture and dairy farming along Dutch and Danish lines.

A River Canyon in the Crimea.

A little-known river gorge or canyon in the South-Eastern Crimea is described by I. Pusanov in *Zemlevedenie*, 1925, vol. **27**, the publication of the geographical section of the Russian Society of Natural History. The gorge is in the Ausun-Usen river, near the village of Kokkos; it is parallel to the Yaila mountains, from which it cuts off the isolated Biyuka massif. The gorge is 3 km. long, 200–250 metres wide, and its almost perpendicular walls are 300 metres high. Though signs of river erosion are now to be seen, the gorge is obviously in a fault plane, and its course parallel to the Yaila mountains is not accidental. The north bank is considerably higher than the south. The whole region requires close study, but a series of faults, breaking the Jurassic limestone into a number of isolated blocks and depressions, can be traced.

AFRICA

The Climate of Helwan, Egypt.

A publication on this subject by Mr. L. J. Sutton (Physical Department Paper No. 20, Cairo, 1926) may be regarded as a companion to the same author's work on the climate of Khartoum (*Journal*, **63**, p. 456). The site of Helwan, 14 miles south of Cairo, was selected for an observatory as representative of desert conditions of Saharan type. There is nothing of the terrific heat of Khartoum, the mean temperature of the warmest month, July, being only 82° F., or 3° below the mean of the whole year in the southern city, whilst January, the coolest month, is down to 54° F. The mean annual range of 38° F. is very large, that of Khartoum being only 23°, but this cannot without correction be taken as an expression of greater thermal "continentality" than prevails in the Sudan on account of the difference of latitude and the smaller change in the seasonal altitude of the sun in the inter-tropical latitude of Khartoum. The absolute range of the thermometer at Helwan during the period 1906 to 1920, between 115° F. and 35° F., is much the same as that observed at Khartoum, but the limits are slightly lower. It is pointed out that this absolute range is smaller than that recorded during the same period at some inland places in the oceanic climate of England—an instance, evidently, of the influence of latitude upon seasonal extremes of temperature.

The winter months in this part of Egypt are described as ideal for invalids. There is on the average as much as seven hours of sunshine a day in the dullest month, December, or about as much as is enjoyed in the sixteen-hour day of May, June, and July in England. The hot season, May to September, when there is fierce sun-glare from the south, is debilitating, though frequent northerly winds tend to moderate the heat. Sandstorms occur, and despite a negligible rainfall occasional severe inundations. That a really low vapour-content is almost impossible for any length of time in warm latitudes is shown by a mean annual vapour-pressure of 9·0 mm., agreeing quite well with 8·4 at Khartoum as against 7·3 at Kew.

The Site of Tegazza.

We have received the following note from Miss E. G. R. Taylor:

"One of the puzzles of the early geography of West Africa has been the site of Tegazza, famous for its salt-mines. Careful plotting of Arab itineraries and study of historical references led the writer to the supposition that there were two Tegazzas, one to the north-west of Taodeni, and another in the

neighbourhood of Tichit. This is confirmed by a passage in J. G. Jackson's Account of the Empire of Morocco (1814), which runs :

" ' In going from Akka to Tagassa they employ 16 days ; . . . they then proceed to the oasis and well of Taodiny, which they reach in 7 days. . . . Their next route is to Arawan, . . . which they reach in 7 days ; . . . and then proceed and reach Timbuctoo the sixth day. . . .

" ' There is another Akkabaah which sets out from Wedinoon and Sok Assa, and traversing the desert between the black mountains of Cape Bojador and Gualata, touches at Tagessa El Gharbie, or West Tagassa, and staying there to collect salt proceeds to Timbuctoo ' (chap. xiii. p. 286)."

AMERICA

The Mackenzie District, North-West Territories, and the Yukon.

A comprehensive survey of a considerable portion of the Mackenzie District is given by Mr. G. H. Blanchet in a publication of the Department of the Interior N.W.T. and Yukon Branch—Great Slave Lake Area, North-West Territories, 1926. It is also interesting as describing stages in the opening up of an undeveloped area comprising about 125,000 square miles lying north of the 60th parallel, with the Great Slave Lake as the chief topographic feature. From several points of view it falls into two divisions, north-eastern and south-western. The former consists of the highly eroded pre-Cambrian rocks, the latter of drift-covered sedimentaries. The line of contact runs approximately down the Slave river and across to the North Arm of the Lake. The plains of the Mackenzie valley and the western end of the Lake contrast strongly with the discontinuous topography and bare rounded rocks of the scarps of the Laurentian plateau, and with the rolling eastern plateau itself, deeply covered with drift. The greater part of this plateau lies between 1000 and 1500 feet (the level of the Great Slave Lake is approximately 500 feet). The whole area displays signs of heavy glaciation, and the lower slopes are covered by old lake bottoms formed when the water stood at approximately the 1000-feet level in post-glacial times. The valleys of the Slave and Mackenzie rivers and the west generally have considerable forests, abundant hay lands, and moose, caribou, and other game, while some farming is possible. To the east forest is found in the valleys, but gradually disappears as the higher levels are reached. The Mackenzie and Slave rivers and the Great Slave Lake afford easy access to the area. On the Laurentian plateau, however, the drainage system is formed merely by lakes spilling uncertainly from one to the other. The eastern end of the Great Slave Lake penetrates well into this plateau, and the falls on its tributaries offer prospects for hydro-electric power sites. This eastern area also gives indication of mineral wealth, and it is upon this, and oil in the sedimentary rocks of the Mackenzie valley, that the hopes for the future are based, as farming can only be a subsidiary occupation.

The prospects of mineral wealth and the beginnings of the survey of the area were noted in the *Journal*, **60**, 316. By 1924 the Great Slave Lake had been completely surveyed, and lines carried to the Great Bear Lake, and, in the east, to Lake de Gras and the Coppermine River. In 1925, 50,000 square miles of practically unknown country in the south-east were opened up, a reconnaissance being made up the Talston river, across the Hudson Bay divide, and some distance down the western branch of the Thelon river. The return to the Great Slave Lake was made by the Snowdrift river. Maps are issued on the scale of 1 inch to 4 miles for navigation and 1 inch to 6 miles for general purposes. Though the presence of great mineral wealth has yet to

be proved, the indications are promising. At present there are six settlements, administrative, mission, and trading. The Indian population approaches 2000.

Another recent publication of this Department deals with the Yukon Territory. Not more favoured by nature than the Great Slave Area for settlement, its development has resulted almost entirely from its gold resources, and this pamphlet deals principally with the mining industry. The output of gold in 1924 was valued at $722,000, compared with the maximum output in 1900 of $22,000,000. The prospect is not however as bad as this might imply, for the lode deposits have yet to be thoroughly examined, and it is stated that barely 20 per cent. of the Territory has been prospected. In the same period the population declined from 27,000 to 4000. The mining industry has stimulated others. Practically all the vegetables consumed are grown in the Territory, farming is increasing, and cattle and sheep are being raised. Similar developments are not impossible in the Great Slave Lake area.

Exploration in Dutch Guiana.

Scientific exploration in the interior of Dutch Guiana, which had been in abeyance for some time, was resumed last year by a well-organized expedition under Dr. Stahel, sent out under the auspices of the Society for the Scientific Exploration of the Netherlands Colonies, with substantial support from the Royal Netherlands Geographical Society. The special field of research is the Wilhelmina range, the central and most important massif in the colony, hitherto practically unknown, where both topographical work and natural history research were felt to be highly desirable, while an examination of the natural resources of this inland region was an important part of the programme. Besides the leader, in charge of the botanical and meteorological work, the *personnel* included Mr. R. Ijzerman as geologist, Dr. Fernandes as zoologist, and Mr. H. C. van Ommeren as medical officer, while the services of a trained surveyor, Col. Kremer, were placed at the disposal of the expedition for a limited period. Reports of progress have been printed as received in the *Tijdschrift* of the Netherlands Geographical Society for July, September, and November 1926 and January 1927, bringing the narrative down to the end of June 1926. The route chosen for the main party was that of the Surinam river and its western headstream the Gran Rio, while Col. Kremer with another section took the route of the Corantyn and its eastern tributary the Lucie, first explored by the expedition of Lieuts. Eilerts de Haan and Kayser in 1910 (see *Journal*, 37, p. 665).

The earlier reports of Dr. Stahel recount the experiences during the ascent of the Surinam and Gran Rio, the usual difficulties being experienced as regards the procuring of canoes, and the navigation of a river much broken by falls and rapids: some unruliness seems also to have been shown by the coolies recruited, it seems, from the "Bush Negroes" of the interior. On reaching the limit of navigation on the Gran Rio (where an inscribed stone was set up to mark the grave of Eilerts de Haan, who there succumbed to fever in 1910) a line was cut through the forest to the Lucie, and this descended to a spot considered most suitable for the overland trip to the mountains. Pending the arrival of Col. Kremer reconnaissances were carried out by Dr. Stahel and Mr. Ijzerman, and a track was cleared by the coolies towards the summits of the range, from which it was proposed to carry out a survey by means of triangulation. One of the peaks, supposed to have a height of 1280 metres (4,200 feet), was climbed and arrangements made to clear the summit of this and other peaks as stations for the triangulation. At an altitude of 900 metres it began to feel cold, and the vegetation suddenly changed, that of the lower

levels giving place to *Cyperaceæ* of the height of a man, big ferns, and (on the actual summit) thickets of dwarf bamboo. Everything was covered with thick cushions of moss dripping with moisture. The whole narrative is interspersed with interesting notes on the plants and animals seen (the latter including jaguars, tapirs, monkeys, peccaries, etc.), and there are special reports on the geology by Mr. Ijzerman. The principal formations are granite, and diabase of two distinct types. A good many *balata* trees of the best kind were seen, and the district is likely soon to become a collecting-ground for this valuable product. Dr. Stahel gives notes on various crafts (including canoe-making) of the Bush Negroes, illustrating them by drawings.

Eastern Bolivia.

A little-known and inaccessible part of Bolivia is described by O. Schmieder in the *Geographische Zeitschrift*, Heft 8, 1926. The east Bolivian upland region lies between the more elevated Puna and the plains of the Chaco, and possesses distinct characteristics. Structurally the area is a series of almost parallel north-and-south ridges, produced by strong tectonic pressure from the west forcing the Mesozoic sandstones and conglomerates into abrupt anticlines. Where the pressure has been stronger overthrusting rather than recumbent folding has resulted. These long steep but low ridges run for several hundred kilometres, at an elevation of 1500–2000 metres. To the east, the intervening valleys are wider, 3–4 kilometres, with flat sandy floors similar to the Chaco. The summer rainfall averages 200 cm., but it varies much from year to year, and is received often as cloudbursts. The summer heat and the high relative humidity is oppressive. The drainage is generally from south to north, or the reverse, but occasionally the larger streams, such as the Parapiti and Pilcomayo, break through the ridges in deep narrow gorges, probably formed by regression. The region is particularly difficult to traverse : progress from east to west is very laborious through the constant ascents and descents. The river gorges are of little use, as they are liable to sudden and dangerous floods. If the journey is made in the dry season fodder for the animals is hard to obtain. The wooded ridges assume a tropical appearance during the rains. On the higher western Andean slopes " pino " and alder forests occur above the 1800-metre line. The native inhabitants, Chiriguanos, immigrants from the upper Paraguay region in the sixteenth century, maintained active opposition to outside influences down to a decade or so ago. Their numbers are declining rapidly, through malaria and other introduced diseases, and through emigration to the economically more active areas of the northern Argentina. Considerable work has been done by Catholic missions, but these are declining and stations are being abandoned. Economically, the region is undeveloped through lack of communications, not from unproductiveness. Maize is grown, pigs raised in the forests, and cattle on the Chaco borders, but outside markets are almost unreachable, and Argentine competition is strong. The prospects for future development depend upon the results of the boring for oil which is at present being carried out, with, it is said, some success.

POLAR REGIONS

Projected Argentine Expedition by Air to the South Pole.

We have received from the author, Señor Antonio Pauly, the copy of a lecture delivered by him last June under the auspices of the Sociedad Argentina de Estudios Geographicos, in which plans were developed for an expedition by aeroplane across the South Polar continent, the exploration of

which, it is pointed out, the Argentine is specially called upon to undertake by reason of her geographical position. Although the project appears to have been pretty thoroughly thought out, and is set down in considerable detail in the paper in question, we are not told how far, if at all, it has yet met with practical support, and the latest news is to the effect that its execution has been postponed for another year, it having been found impossible to carry it out during the present Antarctic summer. The main idea is more or less a revival of Sir Ernest Shackleton's project for a trans-polar journey, only with different and, it is held, more promising means, due to the recent advance in aviation. The starting-point would naturally be on the American side, Wandel Island, off the west coast of Graham Land, being chosen as the most suitable spot for the main base, both on the score of accessibility by sea and because of its generally level surface. Here a scientific station might be established, but only as subordinate to the main expedition. For this a reconnaissance would be carried out by air with a view to choosing a site for a more advanced base on the coast or in the interior of Graham Land, somewhere about the latitude of 70°, and a depôt of petrol would be formed here by a succession of flights from the main base, while exploratory flights would also be made, one to the Weddell Sea, the other to Charcot Land. The final flight across the polar continent would start from this advanced base, landings being made *en route* for the purpose of scientific observations. The ultimate goal would be McMurdo Sound (written "McMurdock" in error), or some other point in the Ross Sea area, where depôts of provisions either already exist or could be laid down by arrangement with the whalers who frequent those regions.

A large part of the paper is taken up with a summary of the physical conditions of the area to be crossed, and Señor Pauly has evidently made himself thoroughly at home with the results of previous work, particularly as regards the meteorological conditions that may be expected to prevail, though the precise influence these would have on the chances of success or otherwise is not very clearly brought out. He lays stress throughout on the facilities for air work afforded by the level expanse, both of the Antarctic "barrier" ice and of the surface of the polar plateau, and he justly insists on the valuable results for geography and kindred sciences that would be yielded by a successful expedition of the kind. Whether he has sufficiently taken account of all the difficulties and chances of misadventure is perhaps open to question. In the choice of the type of aeroplane advantage would of course be taken of the experience of Amundsen, though it is pointed out that the conditions in the Antarctic differ considerably from those to be reckoned with in the north. Another point of difference is the entire absence of local food resources in the south, rendering it necessary for the party to take with them supplies for the whole journey, with a margin also for emergencies. An extra two months' supply of provisions is spoken of, but it is not quite clear how room for this is provided for, the main attention being devoted to the carriage of the petrol. Señor Pauly has had considerable experience of travel in the Andes and other parts of South America, and thinks it possible to do better work with small means well employed than with the elaborate equipment taken by some expeditions. The paper includes notes on the scientific programme and equipment.

GENERAL

Captain Cook's Voyages.

Frequent mention is made by Captain Cook in his journal of his second voyage (1772–75) of a number of medals which he distributed among the natives of the Pacific Islands "as testimonies of our being the first discoverers."

There is a medal in the Banks' Collection in the British Museum and the Royal Mint which is undoubtedly a specimen of those thus distributed. It bears on the obverse the head of George III., and on the reverse two ships, with the inscription " Resolution Adventure. Sailed . from . England March MDCCLXXII." That this was the medal distributed by Cook is supported by descriptions of the medals actually given to the natives, though none of these have been recovered. (See ' The Quest and Occupation of Tahiti by Emissaries of Spain during the years 1772–1776,' Hakluyt Soc., Series II., Vols. **32**, **36**, ed. by Dr. Corney, and a further article by him in the *Numismatic Circular*, 1916.) Up to the present, however, no details of the circumstances of their manufacture or of the engraver have been known.

In a recently published pamphlet, ' Matthew Boulton's " Otaheite " Medal ' (Birmingham, 1926), Mr. A. Westwood gives extracts from correspondence between Boulton and Sir J. Banks, referring to the production of a medal, apparently designed for Cook's second voyage, on which Banks then intended to go. As no other similar medal is known to exist, these references are in all probability to the medal in the Banks collection, though no detailed description is given. It is also established that the engraver of the medal was John Westwood (1744–92), a Birmingham medalist, and not William Barnett or Edward Birch, R.A., as has generally been assumed. This was Boulton's first attempt at medal striking, but he ultimately secured the contract for the copper coinage struck in 1797. He was subsequently associated with James Watt in the historic engineering firm of Boulton and Watt. It will be remembered that Banks did not sail with the second expedition in the end, through a dispute over the accommodation for the scientists on board the *Resolution*, and that re-arrangements delayed the start until July. It is probable, therefore, that on his withdrawal the Admiralty took over Banks' stock of medals.

Another publication dealing with Cook's voyages may be noted here. This is a translation by Miss Tewsley of Zimmerman's account of the third voyage, 1776–80 (originally published in German in 1781; see *Journal*, **68**, 174), issued as Bulletin No. 2 of the Alexander Turnbull Library, Wellington, N.Z., under the direction of Mr. J. C. Andersen. Zimmerman, who was an interested observer, gives from the point of view of an ordinary seaman a brief but clear account of the voyage, of the native customs, and especially of the relations between the crews and the natives, and he describes in more detail the events leading up to Cook's death. He held a very high opinion of his captain's character, but does not hesitate to criticize some of his actions. He mentions incidentally that Cook distributed medals of King George III. to natives of Van Diemen's Land, though Mr. Westwood in the first pamphlet does not specially mention medals for the third voyage.

Congress of Slav Geographers, June 1927.

We have received an intimation that the Second Congress of Slav Geographers and Ethnologists will be held this year in Poland between the 1st and 11th of June, and that visitors from other countries will be admitted to take part in it. The meetings will take place at Warsaw and five other Polish cities in turn, and two special trains will be at the disposal of the members, in which it is proposed to make a tour through a considerable part of the country. The president is Professor E. Romer, and the secretary Professor L. Sawicki, the offices of the organising committee being at 64 Gradzka, Cracow.

OBITUARY

Sir John Scott Keltie.

We have to record with the most profound regret the death of Sir John Scott Keltie, on the afternoon of January 12, after an illness happily very brief. He was present at the Evening Meeting of December 20 very much in his usual health. During the last few years his powers had been a little declining, and his memory not what it was; but he preserved the fresh and vigorous air of a man twenty years younger, and except for occasional touches of bronchitis had been well and active, the most regular attendant at the Council, and the most punctual member of the Geographical Club. On the morning of the Council and Meeting of January 10 he wrote that his doctor would not allow him to come out, but on the following day he was asking when he might be allowed to do so; and on the next he died after a few hours' unconsciousness. The familiar words of the Burial Service on those who come to fourscore years never seemed less appropriate than on the morning of January 15, when his sorrowing friends—past and present officers of the Society, members of the Council, colleagues on the staff, and many others—attended his funeral at the Hampstead Cemetery. He had retired from the office of Secretary in 1915 on reaching the age of seventy-five, but for more than two years after continued during the stress of the war to help in editing the *Geographical Journal*, of which he was the architect and builder. Before he finally retired on his well-earned pension he gave to a Meeting of the Society a vigorous retrospect of its thirty years' work since he joined its permanent staff as Librarian; he continued to manage the affairs of the Geographical Club and to edit the Statesman's Year Book. He remained an active member of the Council of the British Association, collaborated in producing a series of excellent school readers on the story of Geographical exploration, of which the last appeared only a few months ago, and never really gave up golf.

In presenting to him the Victoria Medal of the Society in 1917, Mr. Freshfield said: "He has made himself, and in doing so he has made the Society, a geographical centre round which all good travellers revolve. . . . His correspondence has extended over the civilized world, and . . . Dr. Keltie has remained in the eyes of all men the incarnation of British geography." He would have wished for himself no better epitaph than these last words, and for the moment we will not attempt to enlarge them; but we hope to publish in a future number of this *Journal* a memoir from the hand of one of his older friends.

Professor Jovan Cvijić.

A telegram from the Geographical Society of Belgrade announces the death, on January 16, of the eminent Serbian geographer, Jovan Cvijić, Professor of Geography in the University of Belgrade, and President of the Academy of Sciences. His many friends in this country who knew him during the years of war will realize the profound loss which Yugo-Slavia has suffered by the death of this talented geographer, of whose work on the geography of the Balkans we hope to give some account at a later date, associating all Fellows of the Society meanwhile with the telegram of sympathy which the President despatched to Belgrade on receipt of the news.

Oliver Robert Coales.

We greatly regret to record the death of Mr. O. R. Coales, who had been a Fellow of the Society since 1911, and was well known to its members for his journeys in Western China. He died at Changsha, Hunan, on 26 August 1926, after a sudden illness, at the age of forty-six years.

Mr. Coales had been for twenty-five years a member of His Majesty's Consular Service in China, which he joined as a student interpreter in 1901, and at the time of his death was Consul at Changsha. In the course of his career he undertook several prolonged journeys through little-known parts of Chinese territory. In the late summer of 1910 he travelled across China from east to west, and thence through the provinces of Szechwan, Kansu, and Chinese Turkestan (Sinkiang) to the Trans-Siberian Railway. The record of this journey through a largely unmapped stretch of country was published, with Mr. Coales' route survey, in the *Journal* for February 1912. From 1911 to 1913 he was acting Consul at Wuchow, Kwangsi, and in 1913 and 1914 he was stationed at Shanghai.

In 1915 he was appointed to Tachienlu, in Szechwan, where he was stationed for two years. This post, on the borders of China and Tibet, furnished him with great scope for geographical research, and in the winter of 1916–17 he made a prolonged journey through the little-known country between the upper reaches of the Yalung and the Salween, through the Horpa, Derge, Chamdo, Draya and Markham countries. This journey occupied four months, and in the course of it Mr. Coales was careful to diverge from the beaten track at every possible opportunity, and was accordingly able to achieve many new and valuable results. These results, supplemented by the fruits of his researches into Tibetan folk-lore and the obscure history of the border tribes, were communicated to the Society in a paper read by Mr. Coales on 27 January 1919. The map produced as the result of his survey was published in the *Journal* for October 1919, together with his " Economic Notes on Eastern Tibet."

In 1919 Mr. Coales was appointed His Majesty's Consul at Tengyueh (Yunnan), where he resided from 1921 to 1923. While at this post he did a great deal of travelling on the Burma–China frontier and among the aboriginal tribes of South-West Yunnan, but the results of these investigations do not appear to have been published. W. S. T.

James Irvine.

By the death, in his ninety-second year, of Mr. James Irvine of Birkenhead, which occurred on October 28 last, the Society has lost a Fellow of fifty-six years' standing. When twenty-three years of age he went out to West Africa, and played some part in its commercial development. He is said to have sent to Liverpool the first consignment of palm kernels from that region, though their value was not at first appreciated. He was also interested in the gold-mining industry. In 1864 he began a West African business in Liverpool, where the remainder of his long life was spent. His sustained interest in the welfare of West Africa was marked in 1903 by the bestowal of a decoration upon him by the President of the Republic of Liberia. Mr. Irvine was the grandfather of Alexander C. Irvine, who lost his life with Mallory on the 1924 Mount Everest Expedition. Mr. Irvine had been a Fellow of the Society since 1870.

CORRESPONDENCE

The Alps of Qungur

ON reading Mr. C. P. Skrine's paper on "The Alps of Qungur" (*Geogr. Journ.*, 66, 1925, pp. 385–411), it has occurred to me that a few notes taken passing through on my way to the North-Eastern Tien Shan in 1906 may be of use to future travellers.

I crossed the Muz Tagh Ata range *viâ* the Chichiklik Pass in the latter part of June, taking nine days (June 15–23) from Tashqurghan to Yarkand.

It will be recalled that in mid-July Mr. Skrine had attempted to approach the Shiwakte range from the south *viâ* the Chichiklik, Yangi davan, and Merki Passes and subsequently reach Yangihissar by the Qaratash gorge route, and had found it quite impracticable owing to the condition of the Merki Pass and flooded state of the Qaratash River. The southern routes, the main Shindi (the winter route), and the Tangitar route, with variations possible at certain seasons, were also wholly impracticable. He was therefore forced to take the route that I also, a month earlier in season, had been forced to take, as the only practicable one, though in my case it, by map, took me a big *détour* to attain my objective, which was Yarkand, where I intended to buy my horses for my further progress to the Tekes-Ili country.

In mid-June the ice in the upper part of the Chichiklik Pass made it very difficult for yaks and horses, they having to be hauled up some places with ropes and all loads packed by hand.

The Chichiklik Alpine meadows below the pass were then mostly under snow, and though only a first showing of the flowers, which have given them their name of the "Flowery Meadows," was to be seen at its lower end, one could well appreciate that later on it would be a treasure ground for the botanist.

I found the passage down the very precipitous gorge leading by Tarbashi to Toi-aul-bulung (Mr. Skrine's Toile-bulung) about the limit of roughness possible for pack-animals, the swollen stream being very violent and the bed a mass of loose boulders.

I had camped one night just below the crest of the Chichiklik, next night at Torbashi, and the third at Toi-aul-bulung, where is the junction of the Yangihissar and Yarkand routes, the latter when practicable. Like Mr. Skrine, I found the two passes crossed on the fourth day, the Tari Art (13,340 feet) and Kashka Su (12,900 feet), without difficulty, and the route beyond simply a matter of hard marching all day long to cover space.

One of the objects of my expedition being botanical exploration, I paid particular attention to the very beautiful flora seen on the alpine meadows at the two passes just mentioned, then at its spring height, obtaining over fifty specimens.

I have no doubt the results, when published by the Kew authorities shortly, will show a similarity to Mr. Skrine's collection. There is a remarkable development in brilliant-coloured varieties of the Pedicularis family.

I think the reason for the connection of the flora in this mountain group with that of the Tien Shan and Tibet rather than with the Himalaya is not so much the lofty mountain masses intervening, which would rather tend to form a bridge, as the arid desert-like conditions, the continuous violent prevalent westerly winds and extreme cold due to elevation of the Pamir or southern end of the chain, which surely do form a most effective barrier to all but a few very hardy forms of vegetation.

The most astonishing feature botanically of my journey was the result of

the survey of the low-lying Kashgar basin, the extreme poverty of forms that had been able to establish themselves in this torrid area, their only sources of supply when the former sea disappeared being the highest alpine areas, mountains, and plateaux in the world, extending far and wide around except for one small opening towards the Gobi desert.

My recollection is that I only found some twenty-five or thirty varieties of vegetation established under wild conditions in the entire area, including trees, grasses, and even weeds in cultivated areas. Similarly the magnificent fruit in such abundance at all the oases is without disease; none has ever reached there. On the other hand, the almost daily showers on the alpine meadows of the northern spurs of the Tien Shan have covered the entire country with a rich and beautiful flora, with park-like forests wherever protection from the winds allows, and a rich grass-covering in all open parts that supports unlimited numbers of fine cattle, horses and sheep—the wealth of the Qirghiz.

H. APPLETON, Colonel.

Victoria, British Columbia,
13 November 1926.

MEETINGS: ROYAL GEOGRAPHICAL SOCIETY: SESSION 1926-1927

Fourth Evening Meeting, 20 December 1926.—The President in the Chair.

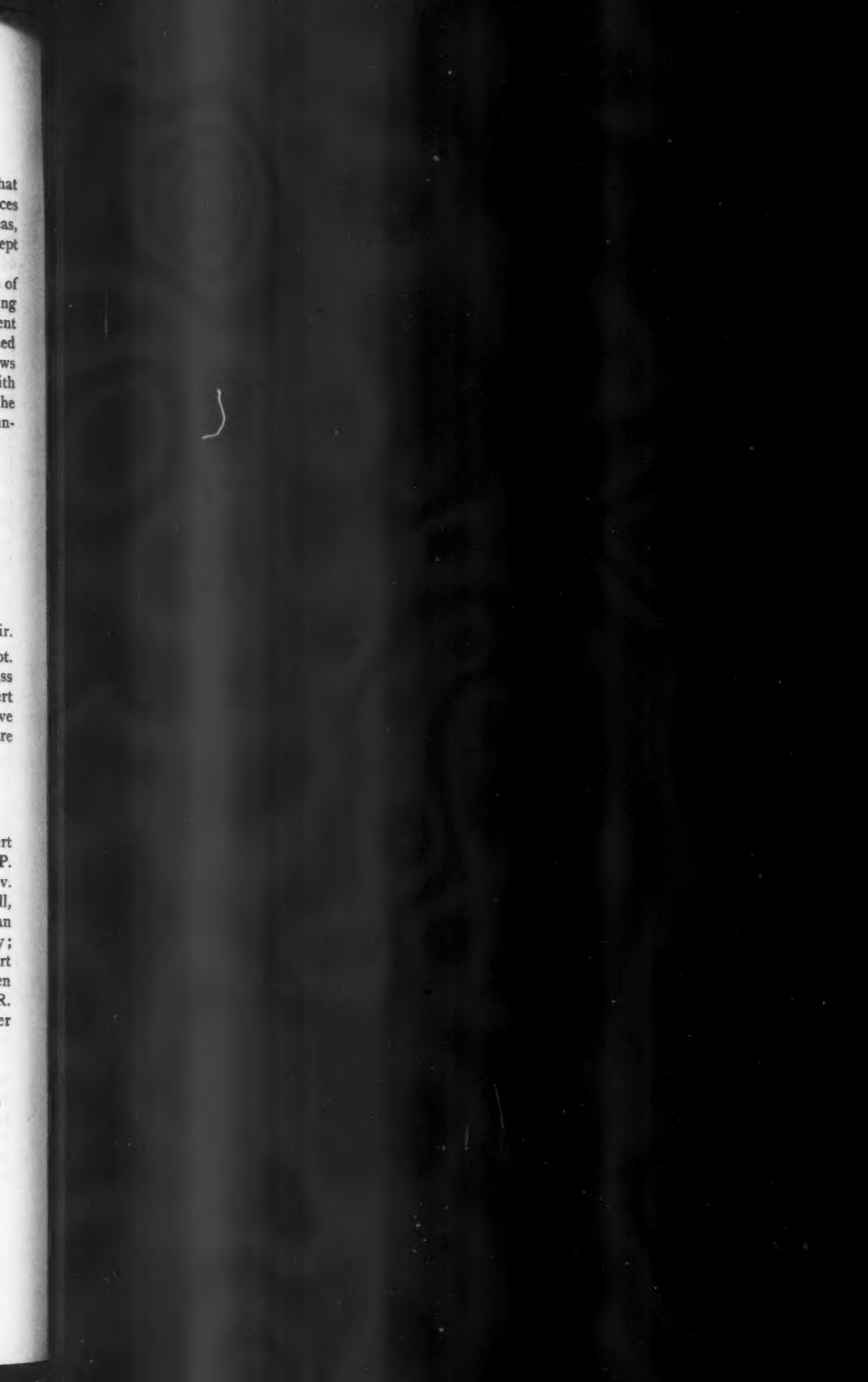
ELECTIONS.—William Adlington; Rev. Richard Alderson, L.TH.; Capt. E. L. O. Baddeley; Major Archibald George Church, D.S.O., M.C.; Miss May de la Cherois Crommelin; Robert Gordon Evans, B.A.; Harold Herbert Fairweather; Collingwood Ingram; Frederick Dudley Jarvis; Miss Olive Jones, L.L.A.; Lala Sohan Lal, B.A., B.T.; Miss Minty Lamb; Theodore Lloyd; Lieut. Ernest Dettmar Wallis, R.N.V.R.

PAPER: The Fiords of the Hebrides. Prof. J. W. Gregory, F.R.S.

Fifth Evening Meeting, 10 January 1927.—The President in the Chair.

ELECTIONS.—Rev. Charles H. R. Baldwin, M.B.E.; Capt. Norman Robert Burgess; Rev. Maxwell Carnson; Luke Wiseman Cornforth; Dr. L. P. Dame; Capt. G. S. H. R. V. de Gaury, M.C.; Albert Fuller Ellis; Rev. Edward Stanley Fellowes-Farrow, M.A.; A. E. Galloway; Major F. W. Hall, M.B.E.; Harry C. K. Henderson, M.A.; James Holmes, B.SC.; Miss Marian Horsfall; Donald Hudson Irving; H. F. Lambart; Henry Langworthy; Ernest A. E. Marno; Mrs. Caroline Sabina Melton; Rev. John Herbert Poole; Mrs. Margot Prickett; Sir Edward Denison Ross, C.I.E.; Mrs. Helen Cameron Russell; Lieut. Charles John Shaw-Mackenzie, M.B.E.; Rev. R. Bevan Shepherd, M.A.; Lars Sjestedt; T. H. Stonborough; Hugh Jelinger Symons, B.A.; Miss Gertrude Caton Thompson.

PAPER: A Periplus of the Persian Gulf. Sir Arnold Wilson.

Third Afternoon Meeting, 17 January 1927.—The President in the Chair.

PAPER: Ships of Early Explorers. Mr. G. S. Laird-Clowes.